LOUDOUN WATER

Broadlands Water Booster Pump Station Phase III Upgrade

Request for Quote

December 22, 2011

Request For Quote
RFQ 2011 018 200
December 22, 2011

BROADLANDS WATER BOOSTER PUMPING STATION
PHASE III UPGRADE

Quote

Loudoun Water, the Owner, is soliciting quotes (Quotes) from Contractors (Bidders) for the Project known as "Broadlands Water Booster Pumping Station Phase III Upgrade" (Project). Bidders shall complete the attached Quote Form and submit their Quote either electronically to constructionbids@loudounwater.org or in a sealed envelope to:

Loudoun Water
44865 Loudoun Water Way
Ashburn, VA 20147
571-291-7700
ATTN: Jack Jadryev RFQ 2011 018 200

Quotes are due by 3:00 pm on February 2, 2012. This solicitation is informal; the Quotes will not be read aloud, and will not be publicly announced. The Contract, if awarded, will be to the lowest responsive, responsible Bidder.

Project Site

The site of the Project (Site) is at 12270 Belmont Ridge Road, Ashburn, Virginia.

Project Description

The Project includes mechanical and electrical work at an existing water booster pumping station located inside the Broadlands Elevated Water Storage Tank #2, including, but is not limited to, the following:

- replacing two existing horizontal mounted 10 HP constant speed pumps with two new 15 HP vertical mounted pumps with variable frequency drives (VFD)
- installing a manual transfer switch and a generator receptacle on the outside of the tank

All new and modified equipment and piping shall be painted to match the existing piping and equipment. A one year warranty is required for all work completed as part of the Project. The Contractor shall test and make fully operational all pumping equipment, complete with all necessary accessories. Contractor shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system.

The terms "Work" and "Project" are used synonymously through this document. The entire scope of the Project can be found on the Contract Documents which are attached hereto for your use.

Site Visit (optional)

The Owner will conduct a Site visit on January 5, 2012 at 10:00 am. Interested Bidders are urged to attend, though attendance is not mandatory for Bidders to submit a Quote. Bidders interested in scheduling a Site visit should contact Jack Jadryev at 571-291-7975.

Questions Concerning this Quote

All questions concerning this Quote shall be submitted in writing at least seven day prior to the date Quotes are due. Bidders may email their questions to constructionbids@loudounwater.org or fax them to 571-223-1527, Attention: Jack Jadryev. Any changes to the Contract Documents prior to the date that Quotes are due shall be made only by addenda issued by Loudoun Water.

Quote Form

All Quotes shall be submitted on the enclosed Quote Form. Bidders shall complete the Quote Form completely for the Quote to be considered responsive.

Payment Terms

Loudoun Water will make partial payments for the Work on a monthly basis upon receipt of Contractor's invoice for Work performed during the month. The Contractor shall submit a final release of liens and claims with the final invoice.

Contract Time

The Contractor shall complete the Work within 120 days of the issuance of Notice to Proceed. This period of performance (Contract Time) may be adjusted only by change order issued by the Owner.

Contract Documents

Contract Documents consist of: 1. this solicitation, 2. Quote Form, 3.Loudoun Water's Standard Terms and Conditions, 4.Pump and Motor data sheets, 5. Contract Specifications (see attachments), 6. Contract Drawings (including Cover Sheet, M1, E1, E2, and E3) prepared by Hazen and Sawyer (work items are indicated in red), and 7. Loudoun Water's engineering design manual (available online). Any changes to the Contract Documents after award of the Contract shall be included in a change order.

General Terms and Conditions

Loudoun Water's Standard Terms and Conditions shall govern the procurement and administration of the Contract. Additionally, the Contractor shall be responsible for securing all permits required for the Project.

Loudoun Water's Engineering Design Manual (EDM), includes a "Standard Details" and an "Approved Materials List" which catalogs manufacturers and products approved for use in Loudoun Water's system. Unlisted items are not approved for use.

Loudoun Water's EDM may be reviewed and/or downloaded at the following website:
http://www.loudounwater.org/Developers-and-New-Construction/Engineering-Design-Manual/

Coordination and Specific Conditions

The Contractor shall cooperate and coordinate with Loudoun Water and other contractors to allow the work of both contracts to proceed concurrently and allow the Owner to operate and maintain the water booster pump station during construction.

One booster pump (either new or existing) shall remain in service at all times during construction.

Liquidated Damages

If the Contractor does not complete the Work within the Contract Time, Liquidated Damages, in the amount of $500 per day, will be assessed for every calendar day beyond the Contract Time until the Contractor completes the Work.

Bidders Declarations

By submitting a Quote, Bidder declares the following:

1. The Quote is submitted in good faith and without fraud, and that it is made without collusion with any official of the Owner;
2. The Bidder has carefully examined the Contract Documents, and addenda (if any) for the construction of the Work;
3. The Bidder has inspected the Site and is satisfied regarding to the quantities including material, equipment, and conditions of the Work involved; and
4. The Contract Time is reasonable for the performance of the Work.

Attachments

Contract Drawings (Cover Sheet, M1, E1, E2, and E3)
Pump and Motor Data Sheet, consisting of 3 pages
Document 01640 – Training, consisting of 6 pages
Document 01650 – Field Testing and Startup Requirements, consisting of 10 pages
Document 16495 - Variable Frequency Drive System, consisting of 19 pages

QUOTE FORM

Project Name: **Broadlands Water Booster Pumping Station Phase III Upgrade**

LCSA Project ID#: 20070164

RFQ #: 2011-018-200

Quote To Owner: Loudoun County Sanitation Authority (DBA Loudoun Water)
44865 Loudoun Water Way
Ashburn, Virginia 20147
(571) 291-7700
jjadryev@loudounwater.org

Bidder's Address: _____

_____

_____

_____

Print Name of Contact Person: _____

Phone Number: _____

In compliance with the OWNER'S Request for Quote, BIDDER hereby proposes to perform all WORK for the construction of the "**Broadlands Water Booster Pumping Station Phase III Upgrade Project ID No. 20070164**" in strict accordance with the CONTRACT DOCUMENTS, within the time set forth therein, and at the prices stated below.

By submission of the QUOTE, each BIDDER certifies, and in the case of a joint QUOTE each party thereto certifies as to his own organization, that this QUOTE has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this QUOTE with any other BIDDER or with any competitor.

BIDDER hereby agrees to commence work under this contract, on or before a date to be specified in the NOTICE TO PROCEED and to complete the PROJECT within 120 consecutive calendar days thereafter.

BIDDER acknowledges receipt of the following ADDENDUM:

No. _____, Date _____

No. _____, Date _____

No. _____, Date _____

Total Lump Sum Quote Price

The BIDDER agrees to perform all work described in the Request for Quote and Contract Documents of the **Broadlands Water Booster Pumping Station Phase III Upgrade Project ID No. 20070164** for the following Total Lump Sum Price:

Contract Item No.	Estimated Quantity	Description of Work Price in Words	Price in Numbers
1	Lump Sum	Total Lump Sum Base Quote: _____ _____ _____ _____ Dollars _____ Cents	$_____

Respectfully Submitted:

_____	_____
Signature	Address
_____	_____
Title	
_____	_____
Date	
_____	_____
Virginia License No.	Federal Employer's Identification No.

SEAL
(if Quote is by a Corporation)

ATTEST: _____

Any contractor submitting a Quote on this project hereby certifies that he has the proper contractor's license and meets all the qualifications required by the statutes of the State and subdivision in which the work is to be performed.

_____	_____
Date	Signature

BIDDER DATA SHEET

BROADLANDS WATER BOOSTER PUMPING STATION
PHASE III UPGRADE
RFQ 2011 018 200

Note: The following information is required as part of your response to this solicitation. The Bidder shall have the capability and capacity in all respects to satisfy fully all of the contractual requirements. Failure to complete and provide this sheet may result in finding your proposal nonresponsive.

Bidder's Primary Contact:
Name: _____ Phone No _____
Email: _____ Fax No _____

Indicate below a listing of at least four (4) current or recent projects, preferable water/wastewater accounts and/or governmental, that your company is servicing, has serviced, or has provided similar services. Include the length of service and the name, address, and telephone number of the point of contact and a brief description of the project:

A. Firm Name _____
Mailing Address _____
_____
Contact _____ Title _____
Phone No. _____ Fax No. _____
Email Address _____
Contract Amount $ _____ Contract Dates _____
Description of Work Performed _____
_____

B. Firm Name _____
Mailing Address _____
_____
Contact _____ Title _____
Phone No. _____ Fax No. _____
Email Address _____
Contract Amount $ _____ Contract Dates _____
Description of Work Performed _____
_____

C. Firm Name _____
Mailing Address _____
_____
Contact _____ Title _____
Phone No. _____ Fax No. _____
Email Address _____
Contract Amount $ _____ Contract Dates _____
Description of Work Performed _____
_____

D. Firm Name _____
Mailing Address _____
_____
Contact _____ Title _____
Phone No. _____ Fax No. _____
Email Address _____
Contract Amount $ _____ Contract Dates _____
Description of Work Performed _____
_____

Loudoun Water
Contract - Standard Terms and Conditions

A. Procedures

The extent and character of the services to be performed by the Bidder (Contractor) shall be subject to the general control and approval of Loudoun Water's General Manager or his authorized representative. Any change to the contract must be approved in writing by the Manger of Procurement and Risk and the Contractor. The Contractor is prohibited from assigning, transferring, conveying, subletting, or otherwise disposing of this agreement or its rights, title or interest therein or its power to execute such agreement to any other person, company or corporation without the prior consent and approval in writing by Loudoun Water.

B. Contract Period

The contract period, also known as Contract Time, is defined as 120 days commencing on the date specified in the Notice to Proceed. The Contract Time shall be changed only by Change Orders.

C. Invoicing and Payment

The firm shall submit invoices for each deliverable (by project), to include a detailed breakdown of all charges. Invoices shall be based upon completion of tasks or deliverables and shall include progress reports.

All such invoices will be paid promptly by Loudoun Water unless any items thereon are questioned, in which event payment will be withheld pending verification of the amount claimed and the validity of the claim. The firm shall provide complete cooperation during any such investigation. All invoices shall reference the Purchase Order and shall be forwarded to the following address:

Loudoun Water
Attn: Accounts Payable
44865 Loudoun Water Way
Ashburn, VA 20147

Individual Contractors shall provide their social security numbers, and proprietorships, partnerships, and corporations shall provide their federal employer identification number on the pricing form.

D. Payments to Subcontractors

1. Within seven days after receipt of amounts paid by Loudoun Water for work performed by a subcontractor under this contract, the Contractor shall either:
   a. Pay the Subcontractor for the proportionate share of the total payment received from Loudoun Water attributable to the work performed by the Subcontractor under this contract; or
   b. Notify Loudoun Water and Subcontractor, in writing, of his intention to withhold all or a part of the Subcontractor's payment and the reason for non- payment.

2. The Contractor shall pay interest to the Subcontractor on all amounts owed that remain unpaid beyond the seven day period except for amounts withheld as allowed in item b. above.

3. The Contractor shall include in each of its subcontracts a provision requiring each Subcontractor to include or otherwise be subject to the same payment and interest requirements as set forth above with respect to each lower-tier subcontractor.

4. The Contractor's obligation to pay an interest charge to a Subcontractor pursuant to this provision may not be construed to be an obligation of Loudoun Water.

E. Ethics in Public Contracting

1. The provisions contained in Sections 2.2-4367 through 2.2-4377 of the Virginia Public Procurement Act as set forth in the 1950 Code of Virginia, as amended, shall be applicable to all contracts solicited or entered into by Loudoun Water.

2. The above-stated provisions supplement, but do not supersede, other provisions of law including, but not limited to, the Virginia State and Local Government Conflict of Interest Act (Section 2.2-3100 et seq.), the Virginia Governmental Frauds Act (Section 18.2-498.1 et seq.) and Articles 2 and 3 of Chapter 10 of Title 18.2. The provisions apply notwithstanding the fact that the conduct described may not constitute a violation of the Virginia State and Local Government Conflict of Interests Act.

F. Delays

If delay is foreseen Contractor shall give thirty (30) days prior written notice to the Division of Procurement. Loudoun Water has the right to extend delivery date if reasons appear, in the sole discretion of Loudoun Water, to be valid. Contractor must keep Loudoun Water advised at all times of status of order. Default in promised delivery (without accepted reasons) or failure to meet specifications, authorizes the Division of Procurement to purchase supplies, equipment or services elsewhere and charge full increase in cost and handling to defaulting Contractor.

G. Notice of Required Disability Legislation Compliance

1. Loudoun Water is required to comply with state and federal disability legislation: The Rehabilitation Act of 1973 Section 504, The Americans with Disabilities Act (ADA) for 1990 Title II and The Virginians with Disabilities Act of 1990.

2. Specifically, Loudoun Water may not, through its contractual and/or financial arrangements, directly or indirectly avoid compliance with Title II of the Americans with Disabilities Act, Public Law 101-336, which prohibits discrimination on the basis of disability by public entities. Subtitle A protects qualified individuals with disability from discrimination on the basis of disability in the services, programs, or activities of all State and local governments. It extends the prohibition of discrimination in federally assisted programs established by the Rehabilitation Act of 1973 Section 504 to all activities of State and local governments, including those that do not receive Federal financial assistance, and incorporates specific prohibitions of discrimination on the basis of disability in Titles I, III, and V of the Americans with Disabilities Act. The Virginians with Disabilities Act of 1990 follows the Rehabilitation Act of 1973 Section 504.

H. Immigration Reform and Control Act of 1986

By entering this Contract, the Contractor certifies that it does not and will not during the performance of this Contract violate the provisions of the Federal Immigration Reform and Control Act of 1986, which prohibits employment of illegal aliens.

I. Insurance

The Contractor shall procure, maintain, and provide proof of insurance coverages for injuries to persons and/or property damage as may arise from or in conjunction with, the work performed on behalf of Loudoun Water by the Contractor, his agents, representatives, employees or subcontractors. Proof of coverage as contained herein shall be submitted fifteen (15) days prior to the commencement of work and such coverage shall be maintained by the Contractor for the duration of the contract period; for occurrence policies. Claims made policies must be in force or that coverage purchased for three (3) years after contract completion date.

1. General Liability

   Coverage shall be as broad as: Comprehensive General Liability endorsed to include Broad Form, Commercial General Liability form including Products/Completed Operations.

   a. Minimum Limits

      General Liability:

      i. $1,000,000 General Aggregate Limit
      ii. $1,000,000 Products & Completed Operations
      iii. $1,000,000 Personal and Advertising Injury
      iv. $1,000,000 Each Occurrence Limit
      v. $50,000 Fire Damage Limit
      vi. $5,000 Medical Expense Limit

2. Automobile Liability

   Coverage sufficient to cover all vehicles owned, used, hired, or non-owned by the Contractor, his agents, representatives, employees or subcontractors.

   a. Minimum Limits

      Automobile Liability:

      i. $1,000,000 Combined Single Limit
      ii. Statutory Uninsured Motorist Coverage
      iii. $1,000,000 Each Occurrence Limit
      iv. $5,000 Medical Expense Limit

3. Workers' Compensation

   a. Limits as required by the Workers' Compensation Act of Virginia.
   b. Employers Liability, $1,000,000
   c. Compliance with all Federal Statutes, including U.S. Longshoreman and Harbor Worker's Act, the Jones Act, and Federal Employee Act.

4. Coverage Provisions

   a. All deductibles or self-insured retention shall appear on the certificate(s).
   b. Loudoun Water, its' officers/ officials, employees, agents and volunteers shall be added as "additional insured" as their interests may appear. This provision does not apply to Professional Liability or Workers' Compensation/Employers' Liability.

c. The Contractor's insurance shall be primary over any applicable insurance or self-insurance maintained by Loudoun Water.
d. Shall provide 30 days written notice to Loudoun Water before any cancellation, suspension, or void of coverage in whole or part, where such provision is reasonable.
e. All coverages for subcontractors of the Contractor shall be subject to all of the requirements stated herein.
f. All deductibles or self-insured retention shall appear on the certificate(s) and shall be subject to approval by Loudoun Water. At the option of Loudoun Water, either; the insurer shall reduce or eliminate such deductible or self-insured retention; or the Contractor shall be required to procure a bond guaranteeing payment of losses and related claims expenses.
g. Failure to comply with any reporting provisions of the policy(s) shall not affect coverage provided Loudoun Water, its' officers/officials, agents, employees and volunteers.
h. The insurer shall agree to waive all rights of subrogation against Loudoun Water, its' officers/officials, agents, employees or volunteers for any act, omission or condition of premises which the parties may be held liable by reason of negligence.
i. The Contractor shall furnish Loudoun Water certificates of insurance including endorsements affecting coverage. The certificates are to be signed by a person authorized by the insurance company(s) to bind coverage on its' behalf, if executed by a broker, notarized copy of authorization to bind, or certify coverage must be attached.
j. All insurance shall be placed with insurers maintaining an A.M. Best rating of no less than an A:VII. If A.M. Best rating is less than A:VII, approval must be received from Loudoun Water's Manger of Procurement and Manager.
k. All coverages designated herein shall be as broad as the Insurance Services Office (ISO) forms filed for use with the Commonwealth of Virginia.

J. Safety

All contractors and subcontractors performing services for Loudoun Water are required and shall comply with all Occupational Safety and Health Administration (OSHA), State and County Safety and Occupational Health Standards and any other applicable rules and regulations. Also all contractors and subcontractors shall be held responsible for the safety of their employees and any unsafe acts or conditions that may cause injury or damage to any persons or property within and around the work site area under this contract.

K. Rider Clause

The Contractor shall, during the term of the contract, extend to any authority, department, agency or institution of the Commonwealth of Virginia the ability to acquire goods and services, other than professional services, at contract prices in accordance with contract terms.

L. Hold Harmless Clause

The Contractor shall, during the term of the contract including any warranty period, indemnify, defend, and hold harmless Loudoun Water, its officials, employees, agents, and representatives thereof from all suits, actions, or claims of any kind, including attorney's fees, brought on account of any personal injuries, damages, or violations of rights, sustained by any person or property in consequence of any neglect in safeguarding contract work or on account of any act or omission by the Contractor or his employees, or from any claims or amounts arising from violation of any law, bylaw, ordinance, regulation or decree.

The Contractor agrees that this clause shall include claims involving infringement of patent or copyright.

M. Not To Benefit
As a prerequisite for payment pursuant to the terms of this contract, there shall be furnished to Loudoun Water a statement, that no employee of Loudoun Water, or members of his immediate family, including spouse, parents or children has received or has been promised, directly or indirectly, any financial benefit, by way of fee, commission, finder's fee or in any other manner, remuneration arising from or directly or indirectly related to a contract resulting from this RFP.

N. Licensure: To the extent required by the Commonwealth of Virginia (*see e.g.* 54.1-1100 *et seq.* of the Code of Virginia), the Contractor shall be duly licensed to perform the services required to be delivered pursuant to any resulting agreement.

O. Exemption from Taxes
Loudoun Water is exempt from State and Federal Taxes. Tax Exemption Certificate indicating Loudoun Water's tax exempt status will be furnished by Loudoun Water on request.

P. Substitutions
NO substitutions, including key personnel, or cancellations permitted after award without written approval by the Manager of Procurement and Risk and Loudoun Water's General Manager.

Q. Assignment of Contract
This contract may not be assigned in whole or in part without the written consent of the Manager of Procurement and Risk.

R. Termination
Subject to the provisions below, the contract may be terminated by Loudoun Water upon thirty (30) days advance written notice to the other party; but if any work or service hereunder is in progress, but not completed as of the date of termination, then this contract may be extended upon written approval of Loudoun Water until said work or services are completed and accepted.

1. *Termination for Convenience*
In the event that this contract is terminated or canceled upon request and for the convenience of Loudoun Water, without the required thirty (30) days advance written notice, then Loudoun Water shall negotiate reasonable termination costs, if applicable.

2. *Termination for Cause*
Termination by Loudoun Water for cause, default or negligence on the part of the Firm shall be excluded from the foregoing provision; termination costs, if any, shall not apply. The thirty (30) days advance notice requirement is waived in the event of Termination for Cause.

3. *Termination Due to Unavailability of Funds in Succeeding Fiscal Years*
When funds are not appropriated or otherwise made available to support continuation of performance in a subsequent fiscal year, the contract shall be canceled and the contractor

shall be reimbursed for the reasonable value of any non-recurring costs incurred but not amortized in the price of the supplies or services delivered under the contract.

S. Contractual Disputes

The Contractor shall give written notice to the Manager of Procurement and Risk of his intent to file a claim for money or other relief at the time of the occurrence or the beginning of the work upon which the claim is to be based.

The written claim shall be submitted to the Manager of Procurement and Risk no later than sixty (60) days after final payment. If the claim is not disposed of by agreement, the Manager of Procurement and Risk shall reduce her decision to writing and mail or otherwise forward a copy thereof to the Contractor within thirty (30) days of receipt of the claim.

The Manager of Procurement and Risk's decision shall be final unless the Contractor appeals within thirty (30) days by submitting a written letter of appeal to the General Manager, or his designee. The General Manager shall render a decision within sixty (60) days of receipt of the appeal.

T. Severability

In the event that any provision shall be adjudged or decreed to be invalid, such ruling shall not invalidate the entire Agreement but shall pertain only to the provision in question and the remaining provisions shall continue to be valid, binding and in full force and effect.

U. Applicable Laws

This contract shall be governed in all respects by the laws of the Commonwealth of Virginia.

V. Employment Discrimination by Contractors Prohibited

Every contract over $10,000 shall include the following provisions:

During the performance of this contract, the Contractor agrees as follows:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age or disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

2. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, shall state that such Contractor is an equal opportunity employer.

3. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient to meet this requirement.

4. The Contractor will include the provisions of the foregoing paragraphs, 1, 2, and 3 in every subcontract or purchase order over $10,000 so that the provisions will be binding upon each subcontractor or vendor.

W. Drug-free Workplace

Every contract of over $10,000 shall include the following provisions:

During the performance of this contract, the Contractor agrees to (i) provide a drug-free workplace for the Contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance including marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or behalf of the Contractor that the Contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order over $10,000 so that the provisions will be binding upon each subcontractor or vendor.

For the purpose of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to an Contractor in accordance with this chapter, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance including marijuana during the performance of the contract.

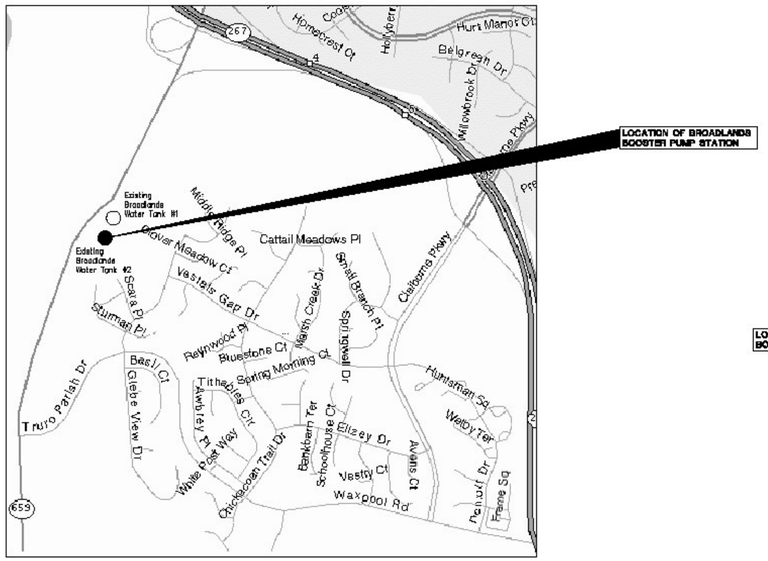
LOUDOUN COUNTY SANITATION AUTHORITY
LEESBURG, VIRGINIA
BROADLANDS WATER BOOSTER PUMP STATION

PHASE III

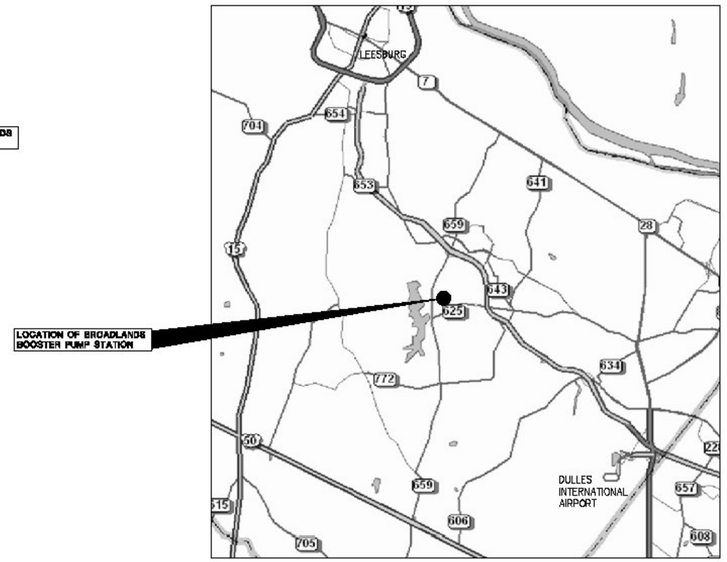
2

LOUDOUN WATER PROJECT ID - 20070164

LCSA
LOUDOUN COUNTY SANITATION AUTHORITY



LOCATION MAP



VICINITY MAP

LEGEND

PROPERTY LINE
EASEMENT
EX FENCE
EX WATER LINE
EX SANITARY SEWER
EX STORM DRAIN
EX CONTOUR LINE
CENTERLINE
WATER LINE

2 HATCHING INDICATES ITEMS TO BE REMOVED

GENERAL NOTES:
1. REMOVED WIRE SHALL BE DISPOSED OF BY THE CONTRACTOR. ALL OTHER REMOVED ITEMS ARE TO BE RETURNED TO THE OWNER.
2. OWNER SHALL PROVIDE INSTRUMENTATION & CONTROL PROGRAMING.

2 BROADLANDS WBPS UPGRADE 10/11
1 RECORD DRAWINGS 04/05

ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR	LR	LONG RADIUS
BF	BLIND FLANGE	MAX	MAXIMUM
BFV	BUTTERFLY VALVE	MIN	MINIMUM
CONC	CONCRETE	MJ	MECHANICAL JOINT
CV	CHECK VALVE	OD	OUTSIDE DIAMETER
DIA	DIAMETER	PE	PLAIN END
DIP	DUCTILE IRON PIPE	PIT	PRESSURE TRANSMITTER
DR	DRAIN	RED	REDUCER
DWG	DRAWING	SCH	SCHEDULE
ECC	ECCENTRIC	SST	STAINLESS STEEL
EF	EACH FACE	STL	STEEL
ESMT	EASEMENT	THK	THICK
EX	EXISTING	TYP	TYPICAL
FE	FLOW ELEMENT	UGE	UNDERGROUND ELECTRIC
FLG	FLANGE	VDOT	VIRGINIA DEPARTMENT OF TRANSPORTATION
GALV	GALVANIZED	W	WATER
GV	GATE VALVE	WCV	WAFER CHECK VALVE
ID	INSIDE DIAMETER		
LCSA	LOUDOUN COUNTY SANITATION AUTHORITY		

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COMMONWEALTH OF VIRGINIA
BRUCE W. PIERSTORFF
Lic. No. 024907
PROFESSIONAL ENGINEER
10-12-11

OCTOBER 2011 2

HAZEN AND SAWYER
Environmental Engineers & Scientists

GENERAL NOTES

A. ALL CONSTRUCTION SHALL CONFORM TO CURRENT LOUDOUN COUNTY, AND LOUDOUN COUNTY SANITATION AUTHORITY (LCSA) STANDARDS AND SPECIFICATIONS.

B. THESE PLANS MAKE NO REPRESENTATION AS TO SUBSURFACE CONDITIONS AND THE PRESENCE OF SUBSURFACE WATER OR THE NEED FOR SUBSURFACE DRAINAGE FACILITIES.

C. THE PROPERTY DELINEATED HEREIN CONTAINS NO KNOWN ARCHEOLOGICAL OR HISTORICAL LANDMARKS.

D. ALL EXISTING UTILITIES MAY NOT BE SHOWN. UTILITIES SHOWN HAVE BEEN TAKEN FROM EXISTING PLANS AND HAVE NOT BEEN FIELD VERIFIED. CONTRACTORS SHALL ARRANGE FOR THE LOCATION OF ALL UNDERGROUND FACILITIES PRIOR TO THE CONSTRUCTION INCLUDING TEST HOLES TO PHYSICALLY LOCATE UNDERGROUND UTILITIES AS NECESSARY.

E. EXISTING STORMWATER CULVERTS, UTILITIES, AND OTHER STRUCTURES SHALL BE PROTECTED FROM DAMAGE DURING CONSTRUCTION. IF DAMAGE OCCURS, THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE RESTORATION OF THE DAMAGED STRUCTURE.

F. CONTACT MISS UTILITIES PRIOR TO ANY SUBSURFACE EXCAVATION.

G. ALL INTERRUPTIONS OF WATER SERVICE SHALL BE SCHEDULED WITH LCSA 72 HOURS IN ADVANCE.

H. CONTRACTOR SHALL NOT OPERATE ANY VALVE IN THE SYSTEM. ALL VALVES SHALL BE OPERATED BY LCSA PERSONNEL.

I. PROVIDE CUTTING-IN-SLEEVES AS NECESSARY TO CONNECT NEW WORK TO EXISTING.

J. ALL BURIED PIPING SHALL BE CLASS 52 (MINIMUM) DUCTILE IRON PIPE WITH RESTRAINED JOINTS.

NOTICE REQUIRED

CONTRACTORS SHALL NOTIFY OPERATORS WHO MAINTAIN UNDERGROUND UTILITY LINES IN THE AREA OF PROPOSED EXCAVATION OR BLASTING AT LEAST TWO WORKING DAYS, BUT NOT MORE THAN TEN WORKING DAYS PRIOR TO COMMENCEMENT OF EXCAVATION OR DEMOLITION

CONTACT "MISS UTILITY" AT
(800) 552-3120
FOR THESE UTILITIES

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LOUDOUN CO. SANITATION AUTHORITY (703) 729-7878

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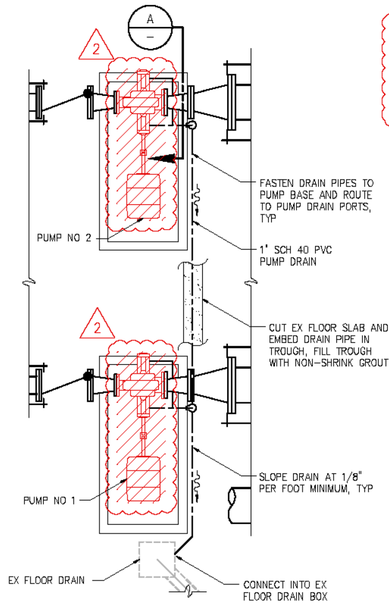
COORDINATE ELECTRICAL SERVICE UPGRADE WITH
DOMINION VIRGINIA POWER
171 ELDEN STREET
HERNDON, VA 20170
MIKE DULIN (703) 375-5957

OWNER
LOUDOUN COUNTY
SANITATION AUTHORITY
DALE C. HAMMES- GENERAL MANAGER
880 HARRISON STREET, S.E.
LEESBURG, VA 20175


A
2
PUMP NO 2
FASTEN DRAIN PIPES TO PUMP BASE AND ROUTE TO PUMP DRAIN PORTS, TYP
1" SCH 40 PVC PUMP DRAIN
CUT EX FLOOR SLAB AND EMBED DRAIN PIPE IN TROUGH, FILL TROUGH WITH NON-SHRINK GROUT
PUMP NO 1
SLOPE DRAIN AT 1/8" PER FOOT MINIMUM, TYP
EX FLOOR DRAIN
CONNECT INTO EX FLOOR DRAIN BOX

PUMP DRAIN LAYOUT

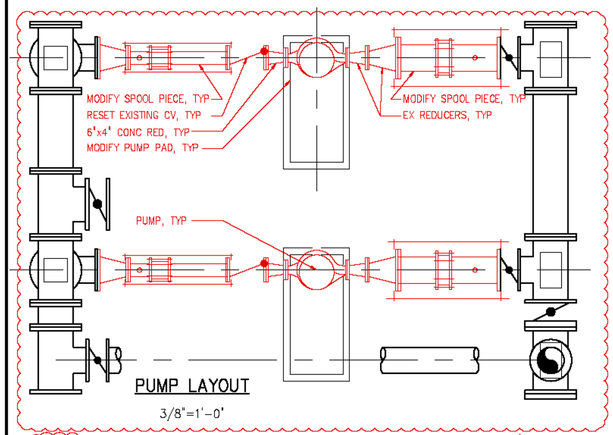
1/2"=1'-0"

SECTION A

1/4"=1'-0"

2

CONTRACTOR SHALL REPLACE EXISTING PUMP AND MOTOR WITH PATERSON PUMP MODEL V4B11A-CC CW AND BALDOR MOTOR MODEL EJMM2513T. SEE NOTES 1 THROUGH 5.



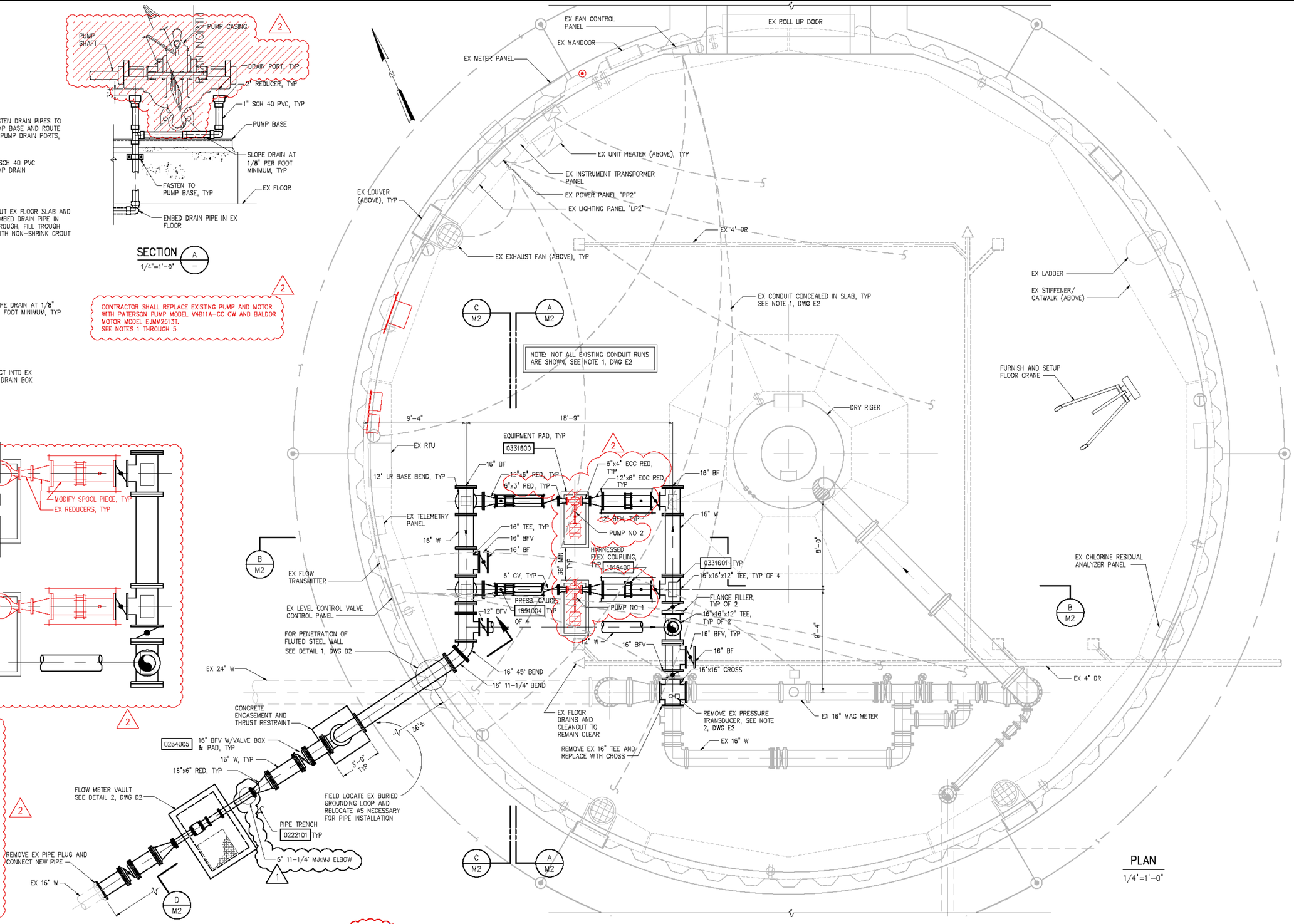
PUMP LAYOUT

3/8"=1'-0"

2

NOTES:

1. CONTRACTOR SHALL ACCOUNT FOR ADDITIONAL LAYING LENGTHS ASSOCIATED WITH NEW REDUCERS AND PUMPS BY MODIFYING THE SUCTION PIPING DOWNSTREAM OF EACH SUCTION BUTTERFLY VALVE.
2. CONTRACTOR SHALL KEEP ONE PUMP IN OPERATION AT ALL TIMES, THROUGH CLOSING BUTTERFLY VALVES LOCATED UPSTREAM AND DOWNSTREAM OF EACH PUMP.
3. CONTRACTOR SHALL MODIFY PUMP DRAIN PIPES TO ACCOUNT FOR NEW PUMP. SPECIFIED PUMP HAS ONE DRAIN PORT.
4. CONTRACTOR SHALL MODIFY PUMP BASE AS NECESSARY TO ACCOUNT FOR NEW PUMP. CONTRACTOR SHALL MOUNT NEW PUMP TO EXISTING PUMP BASE.
5. CONTRACTOR SHALL INSTALL FLEXIBLE COUPLING TO ACCOUNT FOR DIFFERENCES IN SUCTION AND DISCHARGE HEIGHTS ASSOCIATED WITH THE NEW PUMP. COUPLINGS SHALL BE APPROVED BY THE OWNER AND THE ENGINEER.



PLAN

1/4"=1'-0"

NO.	ISSUED FOR	DATE	BY
2	BROADLANDS WBPS UPGRADE	10/11	
1	RECORD DRAWINGS	04/05	

DESIGNED TJL
DRAWN CAS
CHECKED
PROJ.ENGR. TJL
APPROVED

COMMONWEALTH OF VIRGINIA
BRUCE W PIERSTORFF
Lic. No.24957
10-12-11
PROFESSIONAL ENGINEER

HAZEN AND SAWYER
Environmental Engineers & Scientists
4035 Ridge Top Road, Fairfax, Va. 22030

LOUDOUN COUNTY SANITATION AUTHORITY
LEESBURG, VIRGINIA

BROADLANDS WATER BOOSTER PUMP STATION
PHASE III

MECHANICAL PLAN

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE: OCTOBER 2011
H & S JOB NUMBER 30629
CONTRACT NUMBER W-148
DRAWING NUMBER M1
SHEET 1 OF 7

07/11/11 8:15am FILE= O:\32122-FFX\32122-011\drawings\Phase II Drawings (MODIFIED 2011)\M200-JH by CSHENEFIEL XREFs=MISC\30629-bd2, 32122-011\drawings\100\WT-PB,
Plot Stamp: 10-12-2011 8:59am by CSHENEFIEL file:M200-JH_V04.DWG

RECEPTACLES

- DUPLEX RECEPTACLE
  SUBSCRIPT DENOTES TYPE:
  GFCI DENOTES GROUND FAULT CIRCUIT INTERRUPT
  UPS DENOTES UNINTERRUPTABLE POWER SUPPLY
  # DENOTES CIRCUIT
  WPCR DENOTES WEATHERPROOF AND CORROSION RESISTANT
- GENERATOR RECEPTACLE

SWITCHES

- WALL SWITCH
  SUBSCRIPT DENOTES TYPE:
  NO SUBSCRIPT DENOTES SINGLE POLE
  3 DENOTES 3 WAY M DENOTES MANUAL MOTOR STARTER
  4 DENOTES 4 WAY D DENOTES DIMMER
  # DENOTES CIRCUIT
  WPCR DENOTES WEATHERPROOF AND CORROSION RESISTANT
- COMBINATION MOTOR STARTER
- DISCONNECT SWITCH
- LOCAL CONTROL STATION
- SS — SPEED SWITCH

WIRING

- CONDUIT HOME RUN
- CONDUIT EXPOSED
- CONDUIT CONCEALED
- FLEXIBLE CONDUIT

SINGLE LINE

- TX–STRUCTURE DESIGNATION
  2500 kVA
  480–120/208V
  TRANSFORMER
- 3P/4W
  TYPE OF TRANSFORMER
- 100 A — FUSE
- XXX AF / XXX AT — MOLDED CASE CIRCUIT BREAKER
- THERMAL OVERLOAD RELAY
- GROUND
- 600:5A (3) — CURRENT TRANSFORMER
  NUMBER DENOTES QUANTITY
- 480–120V (3) — POTENTIAL TRANSFORMER
  NUMBER DENOTES QUANTITY
- 25 — MOTOR
  NUMBER DENOTES HORSEPOWER
- 15A MCP / DP 1 — FULL VOLTAGE NON–REVERSING STARTER
  NUMBER DENOTES NEMA SIZE
  DP# DENOTES DEFINITE PURPOSE CONTACTOR
  NUMBER DENOTES CONTINUOUS CURRENT RATING OF MCP

MISC PLAN VIEW SYMBOLS

- (E) — EQUIPMENT CONNECTION
- (#) — CONCRETE ENCASED DUCT BANK IDENTIFIER. # DENOTES NUMBER. SEE DUCT BANK SCHEDULE.
- (#) — CONDUIT AND WIRE (SEE LEGEND)

SCHEMATICS

- H O A / XOO / OOX — 3–POSITION SELECTOR SWITCH
  HAND – OFF – AUTO
- START — PUSHBUTTON SWITCH N.O.
  TEXT DENOTES LEGEND PLATE
- STOP — PUSHBUTTON SWITCH N.C.
  TEXT DENOTES LEGEND PLATE
- E–STOP — MUSHROOM HEAD EMERGENCY STOP PUSHBUTTON SWITCH N.C. MAINTAINED
  TEXT DENOTES LEGEND PLATE
- STOP / L.O. — PUSHBUTTON SWITCH N.C. WITH LOCK–OUT
  TEXT DENOTES LEGEND PLATE
- DISCONNECT SWITCH N.O.
- DISCONNECT SWITCH N.C.
- TS — TEMPERATURE SWITCH OR THERMOSTAT N.O.
  TEXT DENOTES TAG NUMBER
- TS — TEMPERATURE SWITCH OR THERMOSTAT N.C.
  TEXT DENOTES TAG NUMBER
- PS — PRESSURE SWITCH N.O.
  TEXT DENOTES TAG NUMBER
- PS — PRESSURE SWITCH N.C.
  TEXT DENOTES TAG NUMBER
- LS — LEVEL SWITCH N.O.
  TEXT DENOTES TAG NUMBER
- LS — LEVEL SWITCH N.C.
  TEXT DENOTES TAG NUMBER
- TR — ON DELAY TIMED SWITCH N.O.T.C.
  TEXT DENOTES TAG NUMBER
- TR — ON DELAY TIMED SWITCH N.C.T.O.
  TEXT DENOTES TAG NUMBER
- TR — OFF DELAY TIMED SWITCH N.O.T.O.
  TEXT DENOTES TAG NUMBER
- TR — OFF DELAY TIMED SWITCH N.C.T.C.
  TEXT DENOTES TAG NUMBER
- TS — TORQUE SWITCH
  TEXT DENOTES TAG NUMBER
- LS — LIMIT SWITCH
  TEXT DENOTES TAG NUMBER
- # — CONTACT (NORMALLY OPEN)
  # DENOTES COIL NUMBER
- # — CONTACT (NORMALLY CLOSED)
  # DENOTES COIL NUMBER
- (R) — INDICATOR LIGHT – LETTER DENOTES COLOR
- PTT (G) — PUSH–TO–TEST INDICATOR LIGHT
  LETTER DENOTES COLOR
- ETM — ELAPSED TIME METER
- SV — SOLENOID VALVE
- MECHANICAL INTERLOCK CONNECTION
- M XXXX — COIL
  M DENOTES MOTOR STARTER
  CR DENOTES CONTROL RELAY
  TR DENOTES TIME DELAY RELAY
  LC DENOTES LIGHTING CONTACTOR
  PR DENOTES INTERPOSING PILOT RELAY
  XXX DENOTES REFERENCE LINE NUMBER

EQUIPMENT/DEVICE LOCATION SYMBOLS

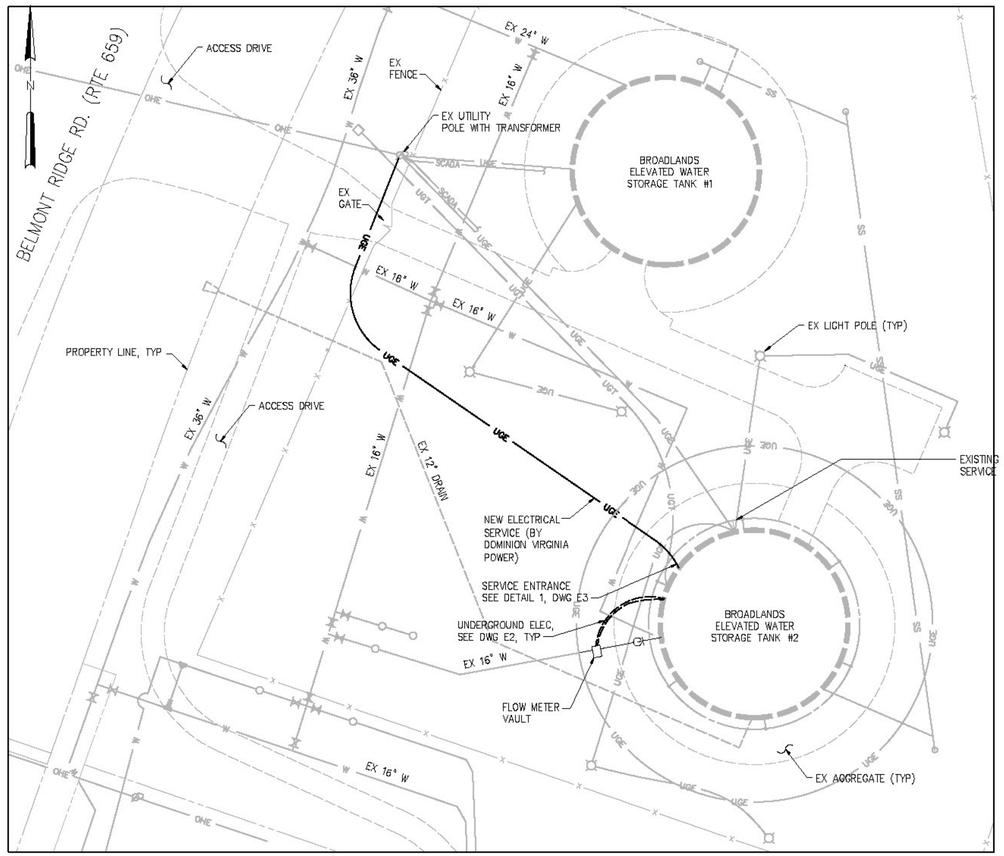
- * — LOCATED AT COMBINATION STARTER
- △ — LOCATED IN FIELD
- 2 ** — LOCATED AT VFD CONTROL PANEL

ABBREVIATIONS

TPS	TWISTED PAIR SHIELDED
FSS	FUSED SAFETY SWITCH
NFSS	NON–FUSED SAFETY SWITCH
SST	STAINLESS STEEL
L_O_R	LOCAL_OFF_REMOTE
H_O_A	HAND_OFF_AUTO
RTU	REMOTE TELEMETRY UNIT
SP. C.	SPARE CONDUIT
UGE	UNDERGROUND ELECTRIC UTILITY
C	CONDUIT
UGT	UNDERGROUND TELEPHONE
VFD	VARIABLE FREQUENCY DRIVE
RECEPT	RECEPTACLE
TYP	TYPICAL
CP	CONTROL PANEL
GEN	GENERATOR

FUNCTIONAL CONTROL DESCRIPTIONS

1. THE EXISTING PUMP STATION CONTROL DESCRIPTION SHALL BE MODIFIED TO PROVIDE OPERATOR SELECTABLE OPTION FOR PRESSURE CONTROL OR FLOW CONTROL AS DESCRIBE BELOW.
2. PRESSURE CONTROL – PROVIDE LOGIC FOR PLC AND OPERATOR INTERFACE UNIT TO PERFORM THE FOLLOWING FUNCTIONAL CONTROL DESCRIPTION:
   A. THE PUMPS SHALL OPERATE IN LEAD/LAG CONFIGURATION TO MAINTAIN A SYSTEM PRESSURE OF 54 PSI AS MEASURED BY THE EXISTING PRESSURE TRANSDUCER/TRANSMITTER (PIT–301).
   B. THE LEAD PUMP SHALL START WHEN THE SYSTEM PRESSURE DROPS BELOW 54 PSI AND SHALL RAMP UP AND DOWN THE SPEED AS REQUIRED TO MAINTAIN THE SYSTEM PRESSURE.
   C. IF THE LEAD PUMP OPERATING AT MAXIMUM SPEED FOR AN ADJUSTABLE TIME PERIOD AND STILL CANNOT MEET THE SYSTEM PRESSURE, THE LAG PUMP SHALL START AT MINIMUM SPEED. BOTH PUMPS SHALL OPERATE AT IDENTICAL SPEEDS AND SHALL RAMP UP AND DOWN TOGETHER AS REQUIRED TO MAINTAIN THE SYSTEM PRESSURE.
   D. IF BOTH PUMPS ARE OPERATING AT MINIMUM SPEED FOR AN ADJUSTABLE TIME PERIOD, THE LAG PUMP SHALL STOP AND THE LEAD PUMP SHALL CONTINUE TO OPERATE TO MAINTAIN THE SYSTEM PRESSURE.
   E. IF THE LEAD PUMP OPERATING AT MINIMUM SPEED FOR AN ADJUSTABLE TIME PERIOD, THE LEAD PUMP SHALL STOP,
3. FLOW CONTROL – THE EXISTING PUMP STATION FUNCTIONAL CONTROL SHALL BE REMAIN BUT SHALL BE MODIFIED TO INCORPORATE THE PUMP SPEED CONTROL FEATURE INTO THE PLC:
   A. NORMAL (375–475 GPM) OPERATION
      THE VFD SHALL VARY THE PUMP SPEED TO KEEP UP WITH DEMAND.
   B. LOW (<375 GPM) FLOW OPERATION
      THE VFD SHALL OPERATE AT THE MINIMUM SPEED SETTING.
   C. HIGH FLOW (>475 GPM) OPERATION
      WHEN THE LEAD PUMP OPERATING AT FULL SPEED AND STILL CANNOT MEET THE DEMAND, THE LAG PUMP SHALL START ON AT MINIMUM SPEED AND VARY IT'S SPEED AS NECESSARY TO MEET THE DEMAND. BOTH PUMPS SHALL OPERATE AT IDENTICAL SPEEDS AND SHALL RAMP UP AND DOWN TOGETHER AS REQUIRED TO MAINTAIN THE FLOW DEMAND.



SITE PLAN
1"=30'

GENERAL ELECTRICAL NOTES:

1. UNLESS OTHERWISE SPECIFIED OR NOTED, ALL WALL MOUNTED ELECTRICAL PANELS, ENCLOSURES, AND SIMILAR EQUIPMENT SHALL BE MOUNTED 6'–6" (MAX) FROM THE TOP OF THE PANEL TO FINISHED FLOOR OR GRADE.
2. UNLESS OTHERWISE NOTED, ALL LIGHTING SWITCHES, CONTROL SWITCHES, AND SIMILAR EQUIPMENT SHALL BE MOUNTED WITH THEIR CENTERLINE APPROXIMATELY 4'–0" ABOVE FINISHED FLOOR, SLAB, OR GRADE. THERMOSTATS SHALL BE MOUNTED 4'–4" ABOVE FINISHED FLOOR.
3. A SEPARATE EQUIPMENT GROUNDING CONDUCTOR SHALL BE PROVIDED FOR EACH CIRCUIT (SEPARATE CONDUCTOR IN THE CONDUIT). THE CONDUCTOR SHALL BE TERMINATED AT THE PROPER DEVICE, TERMINAL OR LUG AT THE POWER SOURCE (MCC GROUND BUS, PANELBOARD GROUND BUS, ETC.). GROUND CONDUCTOR SIZE SHALL BE PER THE LATEST EDITION OF THE NEC.
4. NOTES 1 AND 3 ABOVE ARE APPLICABLE TO THIS UPGRADE. ALL ELECTRICAL WORK SHALL BE PER THE LATEST EDITION OF THE NEC.
5. ALL CONDUCTORS SHALL BE A SEPARATE EQUIPMENT GROUNDING CONDUCTOR SHALL BE PROVIDED FOR EACH CIRCUIT (SEPARATE CONDUCTOR IN THE CONDUIT). THE CONDUCTOR SHALL BE TERMINATED AT THE PROPER DEVICE, TERMINAL OR LUG AT THE POWER SOURCE (MCC GROUND BUS, PANELBOARD GROUND BUS, ETC.). GROUND CONDUCTOR SIZE SHALL BE PER THE LATEST EDITION OF THE NEC.
6. ALL NEW CONDUITS SHALL BE PVC COATED RIGID GALVANIZED STEEL BONDED WITH A 40MIL (MINIMUM) THICKNESS PVC JACKET AND COATED INSIDE WITH URETHANE. ALL CONDUIT FITTINGS AND CONDUIT SUPPORTS SHALL BE PVC COATED AND BE PROVIDED BY THE SAME CONDUIT MANUFACTURER.
7. ALL POWER AND CONTROL WIRE AND CABLES SHALL BE RATED FOR 600 VOLT COPPER CONDUCTOR WITH INSULATION RATED THHN, 90°c FOR DRY LOCATES AND THWN 75°C FOR WET LOCATIONS. CONDUCTORS SHALL BE STRANDED COPPER PER ASTM–B8 AND B–33 AND CLASS B OR C STRANDING CONTINGENT ON THE SIZE.
8. ALL INSTRUMENTATION CABLES FOR ANALOG SIGNALS SHALL BE SINGLE, SHIELDED, TWISTED PAIRS WITH 600 VOLT AND 90°C INSULATION RATINGS. CONDUCTORS SHALL BE TIN OR ALLOY COATED (IF AVAILABLE), SOFT, ANNEALED COPPER, STRANDED PER ASTM–B8, CLASS B STRANDING.
9. ALL RELAYS SHALL BE GENERAL PURPOSE PLUG–IN TYPE WITH COIL VOLTAGE AS SHOWN ON THE DRAWINGS AND SEALED 10 AMPERE CONTACTS. ALL RELAYS SHALL HAVE THREE SPOT CONTACTS RATED 120/240VAC AND 28 VDC MINIMUM. MINIATURE TYPE OR "ICE CUBE" RELAYS ARE NOT ACCEPTABLE.
10. ALL PUSHBUTTONS AND SELECTOR SWITCHES SHALL BE 30.5 mm, HEAVY–DUTY, OIL TIGHT NEMA 4X CORROSION RESISTANT WITH LEGEND PLATS AS INDICATED ON THE DRAWINGS. PUSHBUTTONS SHALL INCLUDE A FULL GUARD.
11. ALL PILOT LIGHTS SHALL BE OF THE PROPER CONTROL VOLTAGE, LED TYPE, PUSH TO TEST, HEAVY–DUTY, CORROSION RESISTANT NEMA 4X WITH LEGEND PLATES AND LENS COLORS AS INDICATED ON THE DRAWINGS.
12. ELAPSE TIME METERS SHALL BE EAGLE SIGNAL TYPE HK210A6, GENERAL TIME CATALOG #ED27NR, ALLEN–BRADLEY EQUIVALENT OR EQUAL.
13. TERMINAL BLOCKS SHALL BE DIN RAIL MOUNTING WITH TUBULAR SCREW TYPE WITH PRESSURE PLAT FOR WIRE SIZE #22 – #8 AWG. POWER TERMINAL BLOCKS SHALL BE SINGLE TIER WITH A MINIMUM OF 600 VOLTS, 30A. SIGNAL TERMINAL BLOCKS SHALL BE SINGLE TIER WITH A MINIMUM OF 600 VOLTS, 20A. SEPARATE TERMINAL STRIPS SHALL BE PROVIDED FOR EACH TYPE OF POWER AND SIGNAL USED.
14. INSTRUMENTATION AND CONTROL PROGRAMMING WILL BE PROVIDED BY OWNER.

MAINTENANCE OF FACILITY OPERATION

1. THE PUMP STATION SHALL REMAIN OPERATIONAL DURING THE UPGRADE. ONE PUMP MUST REMAIN OPERATIONAL AT ALL TIMES. REPLACE ONE PUMP INCLUDING MOTOR STARTER AND CONTROLS, DEMONSTRATE TO THE OWNER THAT THE NEW PUMP OPERATES AS INTENDED. ONLY UPON SATISFACTORY APPROVAL FROM THE OWNER SHALL THE SECOND PUMP BE ALLOWED TO BE REPLACED.

NO.	ISSUED FOR	DATE	BY
2	BROADLANDS WBPS UPGRADE	10/11	
1	RECORD DRAWINGS	04/05	

DESIGNED WCM
DRAWN WCM
CHECKED
PROJ.ENGR. TJL
APPROVED

COMMONWEALTH OF VIRGINIA — BRUCE W. HERSTOFF — Lic. No.24657 — PROFESSIONAL ENGINEER — 10-12-11

HAZEN AND SAWYER
Environmental Engineers & Scientists
4035 Ridge Top Road, Fairfax, Va. 22030

LOUDOUN COUNTY SANITATION AUTHORITY
LEESBURG, VIRGINIA

BROADLANDS WATER BOOSTER PUMP STATION
PHASE III

ELECTRICAL
LEGEND, NOTES AND SITE PLAN

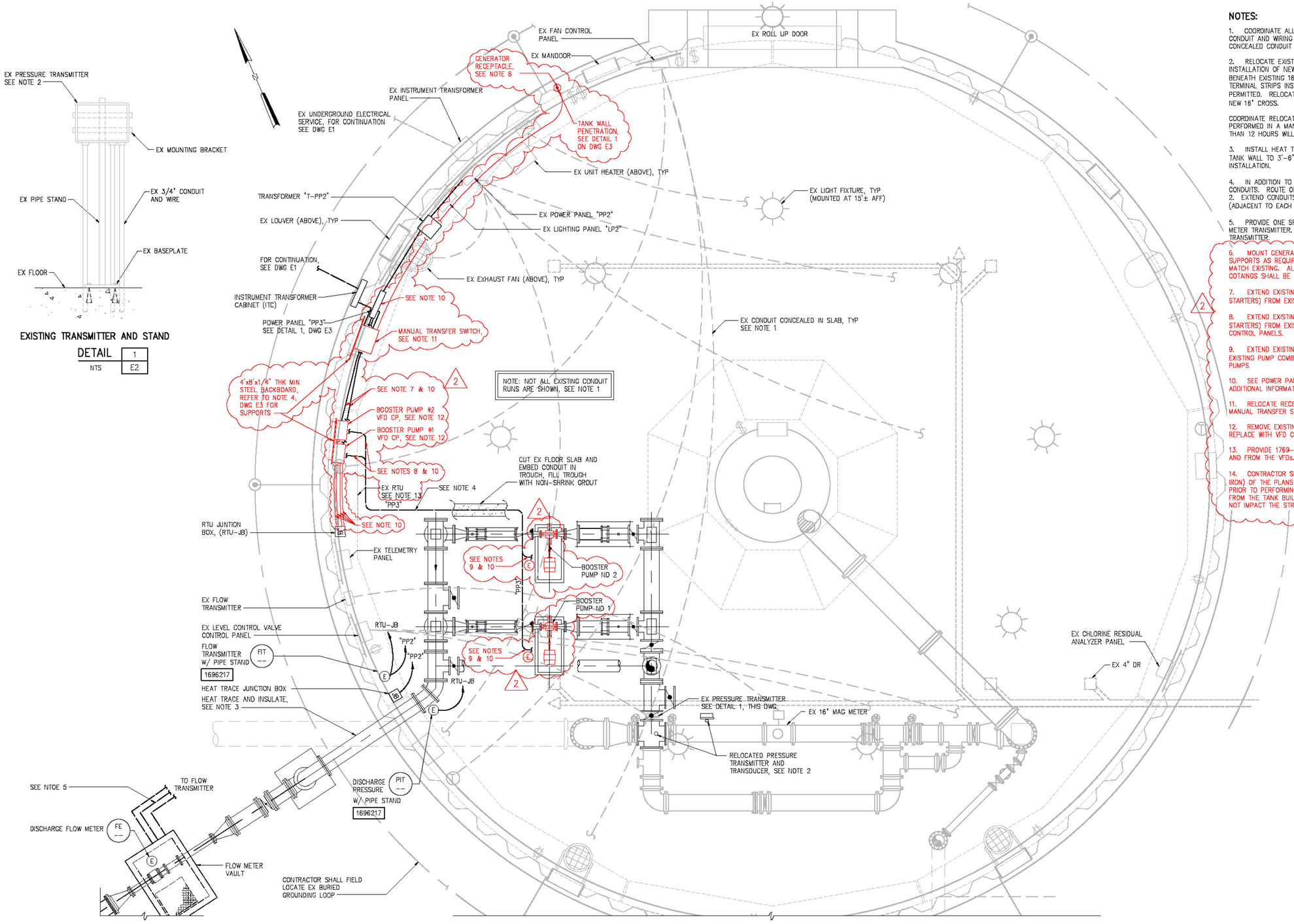
THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE: OCTOBER 2011
H & S JOB NUMBER 30629
CONTRACT NUMBER W–148
DRAWING NUMBER E1
SHEET 3 OF 7

07/11/11 8:33am FILE= G:\32122-FFX\32122-011\drawings\Phase II Drawings (MODIFIED 2011)\E1-TL by CSHENEFIEL XREF FILE = NONE

EXISTING TRANSMITTER AND STAND

DETAIL 1 / NTS E2


EX FAN CONTROL PANEL
EX ROLL UP DOOR
EX MANDOOR
GENERATOR RECEPTACLE, SEE NOTE 6
EX INSTRUMENT TRANSFORMER PANEL
EX UNDERGROUND ELECTRICAL SERVICE, FOR CONTINUATION SEE DWG E1
TANK WALL PENETRATION, SEE DETAIL 1 ON DWG E3
EX UNIT HEATER (ABOVE), TYP
EX LIGHT FIXTURE, TYP (MOUNTED AT 15'± AFF)
TRANSFORMER "T-PP2"
EX LOUVER (ABOVE), TYP
EX POWER PANEL "PP2"
EX LIGHTING PANEL "LP2"
FOR CONTINUATION, SEE DWG E1
EX EXHAUST FAN (ABOVE), TYP
INSTRUMENT TRANSFORMER CABINET (ITC)
SEE NOTE 10
POWER PANEL "PP3" SEE DETAIL 1, DWG E3
MANUAL TRANSFER SWITCH, SEE NOTE 11
EX CONDUIT CONCEALED IN SLAB, TYP SEE NOTE 1
4'x8'x1/4" THK MIN STEEL BACKBOARD, REFER TO NOTE 4, DWG E3 FOR SUPPORTS
SEE NOTE 7 & 10
NOTE: NOT ALL EXISTING CONDUIT RUNS ARE SHOWN, SEE NOTE 1
BOOSTER PUMP #2 VFD CP, SEE NOTE 12
BOOSTER PUMP #1 VFD CP, SEE NOTE 12
SEE NOTES 8 & 10
CUT EX FLOOR SLAB AND EMBED CONDUIT IN TROUGH, FILL TROUGH WITH NON-SHRINK GROUT
EX RTU SEE NOTE 13 "PP3"
SEE NOTE 4
RTU JUNTION BOX, (RTU-JB)
SEE NOTE 10
EX TELEMETRY PANEL
SEE NOTES 9 & 10
BOOSTER PUMP NO 2
BOOSTER PUMP NO 1
EX FLOW TRANSMITTER
EX LEVEL CONTROL VALVE CONTROL PANEL
RTU-JB
"PP2"
FLOW TRANSMITTER W/ PIPE STAND
FIT
1696217
HEAT TRACE JUNCTION BOX
HEAT TRACE AND INSULATE, SEE NOTE 3
EX CHLORINE RESIDUAL ANALYZER PANEL
EX 4" DR
EX PRESSURE TRANSMITTER SEE DETAIL 1, THIS DWG
EX 16" MAG METER
RELOCATED PRESSURE TRANSMITTER AND TRANSDUCER, SEE NOTE 2
SEE NTOE 5
TO FLOW TRANSMITTER
DISCHARGE PRESSURE W/ PIPE STAND
PIT
1696217
DISCHARGE FLOW METER
FE
FLOW METER VAULT
CONTRACTOR SHALL FIELD LOCATE EX BURIED GROUNDING LOOP

PLAN

1/4"=1'-0"

NOTES:

1. COORDINATE ALL PENETRATIONS IN EXISTING SLAB TO AVOID EXISTING CONDUIT AND WIRING CONCEALED IN SLAB. EXACT LOCATION OF EXISTING CONCEALED CONDUIT RUNS IS UNKNOWN.

2. RELOCATE EXISTING PRESSURE TRANSMITTER AND STAND TO ALLOW INSTALLATION OF NEW SUCTION PIPING. EXTEND EXISTING CONDUITS AND WIRE BENEATH EXISTING 16" PIPE TO NEW LOCATION VIA JUNCTION BOX WITH TERMINAL STRIPS INSTALLED NEAR FLOOR. SPLICING OF WIRES IS NOT PERMITTED. RELOCATE PRESSURE TRANSDUCER FROM EXISTING 16" TEE TO NEW 16" CROSS.

COORDINATE RELOCATION AND SHUT DOWN WITH LCSA. RELOCATION MUST BE PERFORMED IN A MANNER TO MINIMIZE DOWN TIME. DOWN TIME OF GREATER THAN 12 HOURS WILL NOT BE ALLOWED.

3. INSTALL HEAT TRACING ON EXPOSED EXTERIOR PIPING. EXTEND FROM TANK WALL TO 3'-6" MINIMUM BELOW GRADE. COORDINATE WITH INSULATION INSTALLATION.

4. IN ADDITION TO REQUIRED POWER CONDUITS, INSTALL 2-1" SPARE CONDUITS. ROUTE ONE CONDUIT TO PUMP NO 1 AND THE OTHER TO PUMP NO 2. EXTEND CONDUITS APPROXIMATELY 6-INCHES ABOVE THE EXISTING FLOOR (ADJACENT TO EACH PUMP BASE) AND CAP EACH CONDUIT.

5. PROVIDE ONE SPARE 1"C FROM THE FLOW METER VAULT TO THE FLOW METER TRANSMITTER. STUB UP AND CAP UNDER THE FLOW METER TRANSMITTER.

6. MOUNT GENERATOR RECPETACLE FLUTED TANK COLUMN, PROVIDE STEEL SUPPORTS AS REQUIRED, SUPPORTS SHALL BE PRIMED AND PAINTED TO MATCH EXISTING. ALL FASTNERS SHALL BE STAINLESS STEEL. DAMAGE TANK COTAINGS SHALL BE REPAIRED TO MATCH ORIGINAL CONDITION.

7. EXTEND EXISTING CONDUITS (FOR DEMOLISHED PUMP COMBINATION STARTERS) FROM EXISTING POWER PANEL PP3 TO NEW VFD CONTROL PANELS.

8. EXTEND EXISTING CONDUITS (FOR DEMOLISHED PUMP COMBINATION STARTERS) FROM EXISTING BOOSTER PUMPS (TO BE DEMOLISHED) TO NEW VFD CONTROL PANELS.

9. EXTEND EXISTING CONDUITS (FOR DEMOLISHED BOOSTER PUMPS) FROM EXISTING PUMP COMBINATION STARTERS (TO BE DEMOLISHED) TO NEW BOOSTER PUMPS.

10. SEE POWER PANEL PP3 SINGLE-LINE DIAGRAM ON DWG E3 FOR ADDITIONAL INFORMATION.

11. RELOCATE RECEPTACLES, CONDUITS, ETC. AS REQUIRED TO MOUNT MANUAL TRANSFER SWITCH AND BACKBOARD.

12. REMOVE EXISTING BOOSTER PUMP COMBINATION STARTER PANEL AND REPLACE WITH VFD CONTROL PANEL.

13. PROVIDE 1769-OF4 AND 1769-IF8 MODULES FOR 4-20 mA SIGNALS TO AND FROM THE VFDs.

14. CONTRACTOR SHALL NOTIFY THE TANK BUILDER (CHICAGO BRIDGE AND IRON) OF THE PLANS TO INSTALL A PENETRATION THROUGH THE TANK WALL PRIOR TO PERFORMING THE WORK. CONTRACTOR SHALL RECEIVE CONFIRMATION FROM THE TANK BUILDER THAT THE PENETRATION IS ACCEPTABLE AND WILL NOT IMPACT THE STRUCTURAL INTEGRITY OF THE TANK.

NO.	ISSUED FOR	DATE	BY
2	BROADLANDS WBPS UPGRADE	10/11	
1	RECORD DRAWINGS	04/05	

DESIGNED WCM
DRAWN WCM
CHECKED
PROJ.ENGR. TJL
APPROVED

COMMONWEALTH OF VIRGINIA
BRUCE W. MERSTORFF
Lic. No.24857
10-17-11
PROFESSIONAL ENGINEER

HAZEN AND SAWYER
Environmental Engineers & Scientists
4035 Ridge Top Road, Fairfax, Va. 22030

LOUDOUN COUNTY SANITATION AUTHORITY
LEESBURG, VIRGINIA

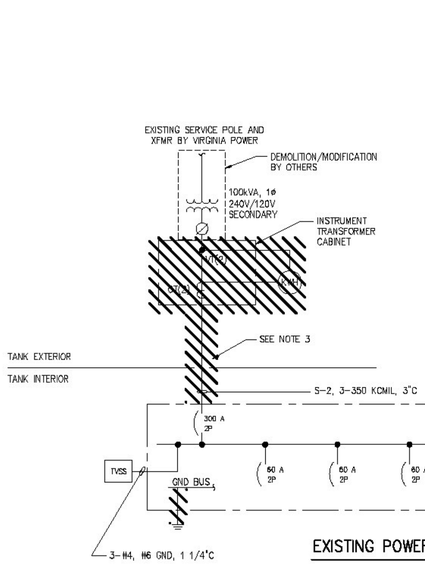
BROADLANDS WATER BOOSTER PUMP STATION
PHASE III

ELECTRICAL
PLAN

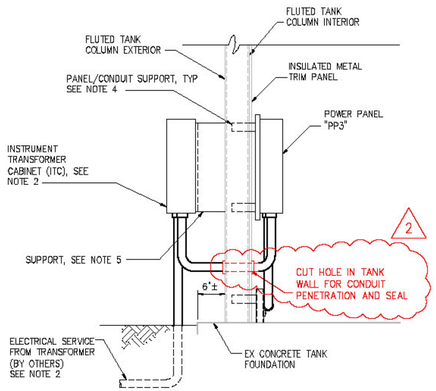
THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

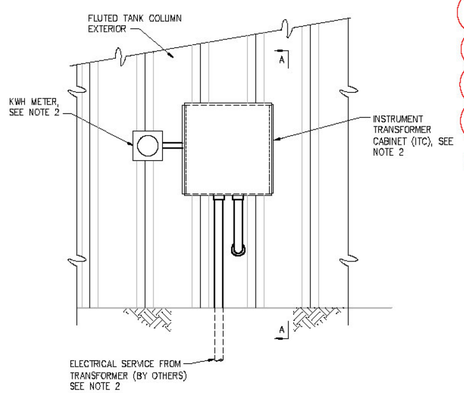
DATE: OCTOBER 2011
H & S JOB NUMBER 30629
CONTRACT NUMBER W-148
DRAWING NUMBER E2
SHEET 4 OF 7

7/7/03 2:25pm FILE= H:\30629\ELEC\201 by THOM XREFs=MISC\30629-bs2, 100\WT-PB,



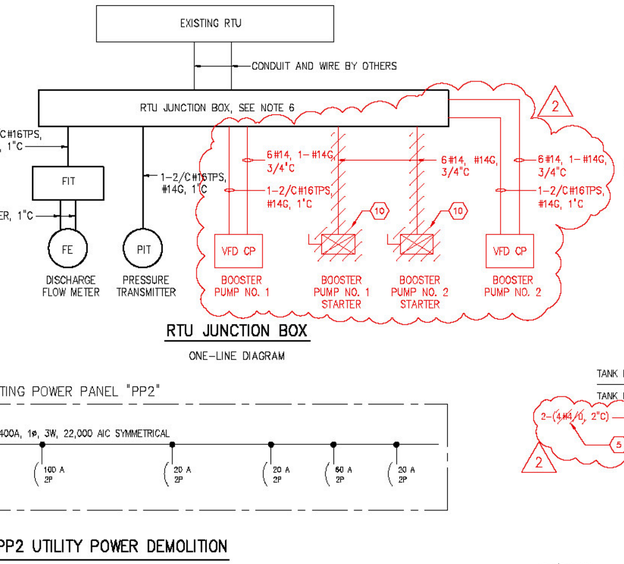
EXISTING POWER PANEL PP2 UTILITY POWER DEMOLITION


FLUTED TANK COLUMN INTERIOR
FLUTED TANK COLUMN EXTERIOR
INSULATED METAL TRIM PANEL
PANEL/CONDUIT SUPPORT, TYP SEE NOTE 4
POWER PANEL "PP3"
INSTRUMENT TRANSFORMER CABINET (ITC), SEE NOTE 2
SUPPORT, SEE NOTE 5
6'±
CUT HOLE IN TANK WALL FOR CONDUIT PENETRATION AND SEAL
ELECTRICAL SERVICE FROM TRANSFORMER (BY OTHERS) SEE NOTE 2
EX CONCRETE TANK FOUNDATION


FLUTED TANK COLUMN EXTERIOR
KWH METER, SEE NOTE 2
INSTRUMENT TRANSFORMER CABINET (ITC), SEE NOTE 2
A
A
ELECTRICAL SERVICE FROM TRANSFORMER (BY OTHERS) SEE NOTE 2

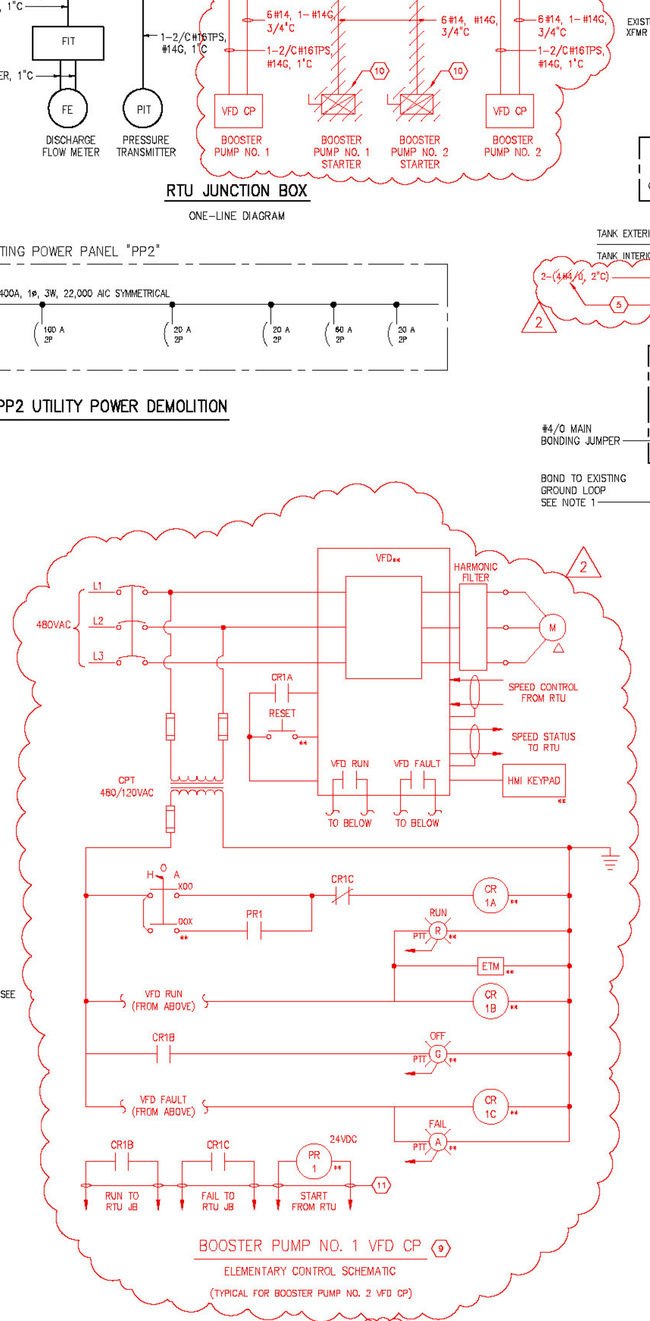
ELECTRICAL SERVICE PANEL DETAIL

DETAIL 1 — 1/4"=1'-0" — E3



RTU JUNCTION BOX

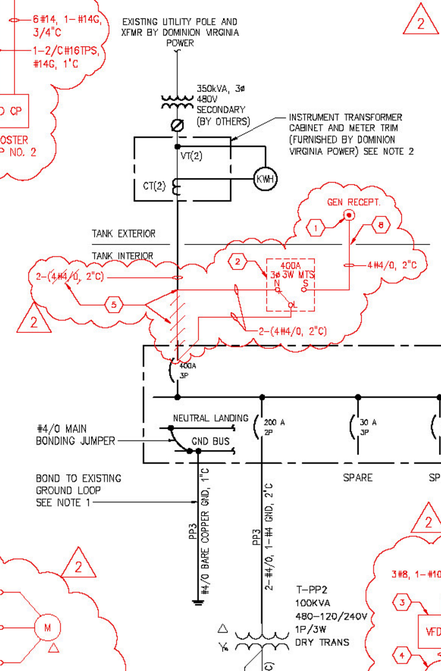
ONE-LINE DIAGRAM

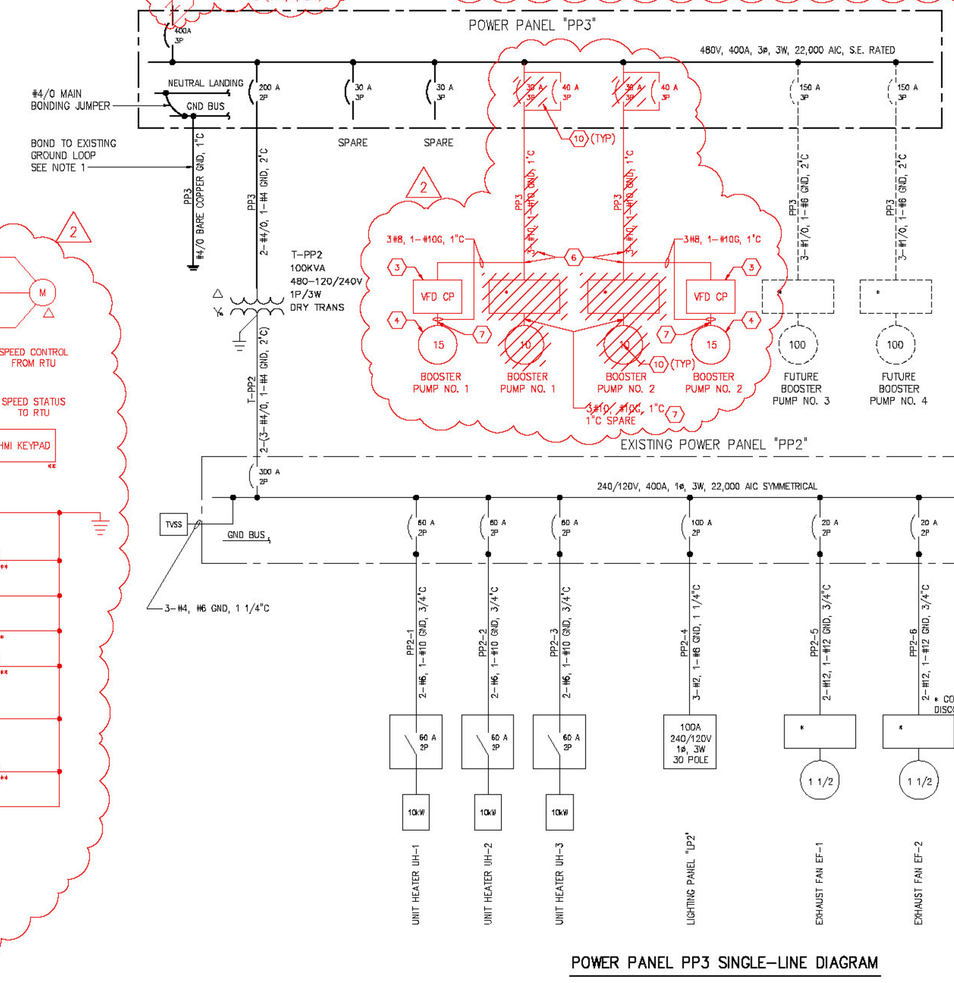


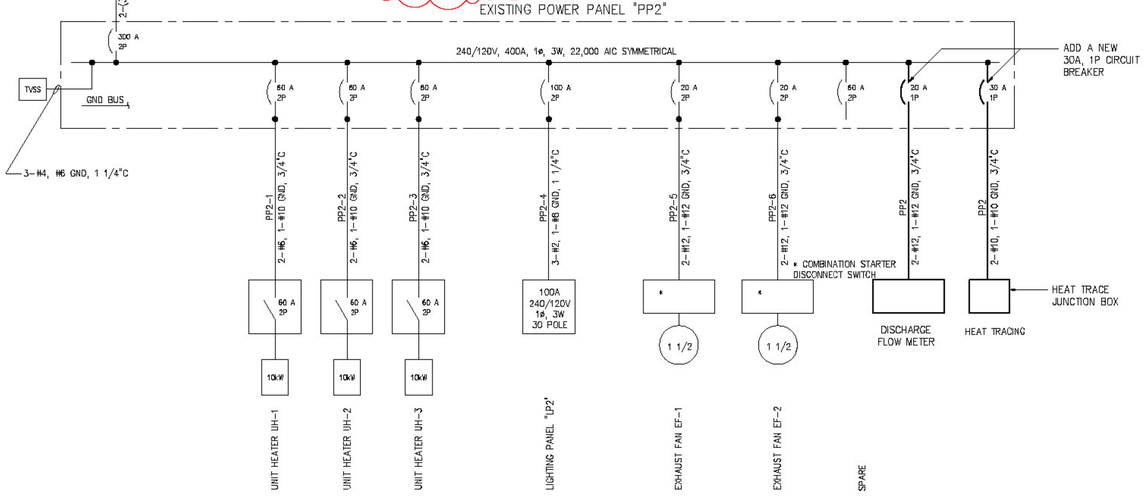
BOOSTER PUMP NO. 1 VFD CP (9)

ELEMENTARY CONTROL SCHEMATIC

(TYPICAL FOR BOOSTER PUMP NO. 2 VFD CP)







POWER PANEL PP3 SINGLE-LINE DIAGRAM

KEYED NOTES:

1. GENERATOR RECEPTACLE – COOPER CROUSE-HINDS ARKTITE MODEL AREAL20317-S22. PROVIDE COMPLETE RECEPTACLE WITH PLUG CLOSURE CAP.
2. MANUAL TRANSFER SWITCH (MTS) – EATON SERVICE ENTRANCE RATED NON-AUTOMATIC BREAKER-BASED TRANSFER SWITCH MODEL NTHELDB30400XJU WITH REQUIRED TERMINAL QUANTITIES.
3. VFD – ROCKWELL AUTOMATION POWERFLEX 700 MODEL 20BD022AJAYNAEDB IN A NEMA 12 GASKETED STEEL ENCLOSURE BY HOFFMAN, SIZED AS REQUIRED. ENCLOSURE SHALL BE OUTFITTED WITH AIR FILTERS AND FANS AS RECOMMENDED BY THE MANUFACTURER AND A HARMONIC FILTER ON OUTPUT POWER TO MOTOR.
4. PUMP MOTOR – SEE MECHANICAL DRAWING FOR ADDITIONAL INFORMATION.
5. DISCONNECT AND REMOVE EXISTING CONDUCTORS BETWEEN UTILITY TRANSFORMER AND POWER PANEL PP3; EXISTING CONDUITS TO BE-USED. EXTEND EXISTING CONDUITS FROM INSTRUMENT TRANSFORMER CABINET TO NEW MANUAL TRANSFER SWITCH AND REMOVE PORTIONS OF EXISTING CONDUITS TO POWER PANEL PP3. PROVIDE NEW CONDUCTORS AS SHOWN. COORDINATE WITH ELECTRIC UTILITY AS REQUIRED.
6. DISCONNECT AND REMOVE EXISTING CONDUCTORS BETWEEN POWER PANEL PP3 AND BOOSTER PUMP MOTOR STARTER PANEL (BPMSP); EXISTING CONDUIT TO BE RE-USED. REMOVE EXISTING BPMSP AND INSTALL NEW VFD IN THE SAME LOCATION. EXTEND EXISTING CONDUITS FROM POWER PANEL PP3 TO NEW VFD AND PROVIDE NEW CONDUCTORS AS SHOWN. MODIFY MOUNTING SUPPORT AS REQUIRED.
7. DISCONNECT AND REMOVE EXISTING CONDUCTORS BETWEEN BOOSTER PUMP MOTOR STARTER PANEL AND BOOSTER PUMP; EXISTING CONDUIT TO BE RE-USED. EXTEND EXISTING CONDUITS TO NEW VFD AND NEW BOOSTER PUMP AND PROVIDE NEW CONDUCTORS AS SHOWN.
8. CUT HOLE IN EXISTING TANK WALL FOR CONDUIT PENETRATION AND SEAL, SEE DETAIL 1/E3 THIS DRAWING.
9. ALL CONTROLLING DEVICES, DISPLAYS AND METERS SHALL BE MOUNTED ON THE EXTERIOR OF THE PANEL DOOR.
10. EQUIPMENT TO BE REMOVED, TYPICAL.
11. SIGNAL EXISTS AT RTU (FOR EXISTING BOOSTER PUMP MOTOR STARTER PANELS TO BE DEMOLISHED) AND WILL BE RE-USED FOR NEW VFD CONTROL PANEL.

NOTES:

1. FIELD LOCATE AND VERIFY LOCATION OF EXISTING GROUND LOOP; RELOCATE AS NECESSARY.
2. COORDINATE WITH UTILITY (DOMINION VIRGINIA POWER (DVP); MIKE DULIN (703) 375-5957) FOR ELECTRICAL MODIFICATIONS. INSTRUMENT TRANSFORMER CABINET (ITC) AND METER ENCLOSURE ARE FURNISHED BY DVP AND INSTALLED BY THE CONTRACTOR. METER WIRING WILL BE INSTALLED BY DVP. ALL INSTALLATIONS SHALL BE PERFORMED IN ACCORDANCE WITH DVP REQUIREMENTS. PROVIDE AND INSTALL CONDUIT FROM ITC TO POWER PANEL "PP3." DVP WILL PROVIDE AND INSTALL THE ELECTRICAL SERVICE CONDUCTORS AND CONDUIT FROM THE SERVICE POLE TO THE LINE SIDE OF THE CT'S. OWNER WILL PAY ALL FEES ASSOCIATED WITH DVP FURNISHED MATERIALS AND SERVICES. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COORDINATION AND SCHEDULING WITH DVP.
3. AFTER COMPLETEION OF SERVICE UPGRADE, DEMOLISH EXISTING INSTRUMENT CABINET, METER, GROUNDING CONDUCTOR, CONDUIT AND WIRE. REPAIR HOLE IN TANK WALL WITH 1/4" THICK (MINIMUM) STEEL PLATE, CUT TO FIT. TANK PATCH SHALL BE WELDED IN PLACE AND TANK COATING SHALL BE REPAIRED AS SPECIFIED. SUPPLY POWER PANEL "PP2" AS SHOWN.
4. INTERIOR PANELS AND EQUIPMENT SHALL BE SUPPORTED WITH STEEL BRACKETS BOLTED TO THE FLUTED STEEL COLUMN. CONDUITS SHALL BE SUPPORTED IN SIMILAR MANNER OR FROM CONCEALED CIRTS THAT SUPPORT METAL TRIM PANELS. NO EQUIPMENT, PANELS OR CONDUIT SHALL BE ATTACHED DIRECTLY TO THE INTERIOR METAL TRIM PANELS. BRACKETS SHALL BE FABRICATED OF STEEL AND PRIMED AND PAINTED AS SPECIFIED. ALL FASTENERS SHALL BE STAINLESS STEEL. TRIM PANELS AND INSULATION SHALL BE REMOVED AND REINSTALLED AS NECESSARY FOR SUPPORT INSTALLATION. PENETRATIONS AND CUT EDGES OF TRIM PANELS SHALL BE CUT NEATLY AND SHARP EDGES SHALL BE REMOVED. DAMAGED TANK COATINGS SHALL BE REPAIRED AS SPECIFIED.
5. SUPPORT INSTRUMENT TRANSFORMER CABINET SO THAT REAR OF PANEL IS ALIGNED WITH EDGE OF EXISTING FOUNDATION (APPROXIMATELY 6-INCHES). SUPPORTS SHALL BE FABRICATED OF STEEL AND BOLTED TO FLUTED TANK COLUMN. SUPPORTS SHALL BE PRIMED AND PAINTED AS SPECIFIED. ALL FASTENERS SHALL BE STAINLESS STEEL. DAMAGED TANK COATINGS SHALL BE REPAIRED AS SPECIFIED.
6. LOCATE JUNCTION BOX WITHIN 2 FEET OF EXISTING RTU.

NO.	ISSUED FOR	DATE	BY
2	BROADLANDS WBPS UPGRADE	10/11	
1	RECORD DRAWINGS	04/06	

DESIGNED WCM
DRAWN WCM
CHECKED
PROJ.ENGR. TJL
APPROVED

COMMONWEALTH OF VIRGINIA — BRUCE W. FURSTORFF — Lic. No.24957 — PROFESSIONAL ENGINEER — 10-12-11

HAZEN AND SAWYER
Environmental Engineers & Scientists
4035 Ridge Top Road, Fairfax, Va. 22030

LOUDOUN COUNTY SANITATION AUTHORITY
LEESBURG, VIRGINIA

BROADLANDS WATER BOOSTER PUMP STATION
PHASE III (2)

ELECTRICAL
SINGLE-LINE DIAGRAMS, SCHEMATICS, AND DETAILS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE: OCTOBER 2011 (2)
H & S JOB NUMBER 30629
CONTRACT NUMBER W-148
DRAWING NUMBER E3
SHEET 5 OF 7

07/11/11 7:57am FILE= O:\32122-FFX\32122-011\drawings\Phase II Drawings (MODIFIED 2011)\E3-1L by CSHENEFIEL XREF FILE = NONE

Pump and Motor Data Sheet

Patterson Vertical In-Line Close Coupled HVAC Pump – No “or equals” or substitutes will be accepted
Model V4B11A-CC CW Rotation Impeller Dia.: 10.0625”
Pump Size: 4X4X11
Rated RPM: 1770
475 GPM TDH Calculated Efficiency @ Duty Point: 73%
Break HP: 12.92
Non Overloading HP: 14.7
NPSHR (feet): 14.4
Maximum Pump Working Pressure: 175#
Motor: 60 HZ - 208V, 15 HP, ODP-PE, NEMA Design B
Baldor Model #: EJMM2513T

Options – Pump to include 416 stainless steel shaft
Motor to include 120 VAC winding space heaters and the stator shall be equipped with six (6) thermistor resistance temperature detectors (RTD’s) embedded in the end coils of the stator winding (2 RTD’s per stator phase).

Owner will not be present for factory hydrostatic and performance tests. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof, shall be submitted for review. No such equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable. Pumps shall be certified to be free from excessive vibration, cavitation, noise, and oil or water leaks. Vibration shall not exceed the Acceptable Peak to Peak Displacement per Frequency shown on Figure 75 for “Rigid Structures” of the Hydraulic Institute Standards. Pump nameplates shall include a minimum of three design capacity and total dynamic head points, which correspond to the factory tested capacity of the pump at the time of manufacture.

Field testing, startup and Reliability/Demonstration Testing are prerequisites to Substantial Completion and, therefore, shall be completed within the time specified for Substantial Completion.

Pumps shall be provided complete with all accessories, shims, couplings, fasteners, lubricants, pump base and other appurtenances as specified, and as may be required for a complete and operating unit.

The Contractor shall furnish and install pressure gauges with diaphragm-type isolation seals on the suction and discharge of each pump.

- Suction gauges shall be Ashcroft Duralife Model 1009 3-1/2” liquid-filled gauges with stainless steel case, ¼” NPT, lower stem mount type, ±1% full scale accuracy, stainless steel bourdon tube pressure element and stainless steel, Teflon coated pinion gear and segment movement with a range of 0 to 100 psi.
- Discharge gauges shall be Ashcroft Duralife Model 1009 3-1/2” liquid-filled gauges with stainless steel case, ¼” NPT, lower stem mount type, ±1% full scale accuracy,

stainless steel bourdon tube pressure element and stainless steel, Teflon coated pinion gear and segment movement with a range of 0 to 200 psi.

- A ¼" isolation stainless steel ball valve and an Ashcroft All Welded "Mini" Diaphragm Seal Type 310, shall be provided for each gauge assembly.

All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with galvanized steel pipe or copper tube, properly supported with brackets.

One set of spare parts shall be provided including:

Set of Gaskets and O-Ring Seals
One Mechanical Shaft Seal Assembly
One Casing Wear Ring
One Impeller
One Shaft Sleeve
Five Tubes of Manufacturer Suggested Bearing Lubrication Grease

Pump Data Sheet - Patterson HVAC Pumps

Company: LCSA - Jack Jadryev
Name: Red Dot 19C - Inline
Date: 2/15/2011

Pump:

Model: V4B11A-CC

Type: VIL
Synch speed: 1800 rpm

Speed: 1770 rpm
Dia: 10.0625 in

Size: 4x4x11

Impeller: D05-90019

Specific Speeds:

Ns: 1064
Nss: 5492

Dimensions:

Suction: 4 in
Discharge: 4 in

Pump Limits:

Temperature: ---
Pressure: ---
Sphere size: ---

Power: ---
Eye area: ---

Search Criteria:

Flow: 475 US gpm

Head: 80 ft

Fluid:

Water
SG: 1
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: ODP

Size: 15 hp
Speed: 1800
Frame: See Chart

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	475 US gpm
Head:	80.6 ft
Eff:	73.8%
Power:	13.1 hp
NPSHr:	14.4 ft

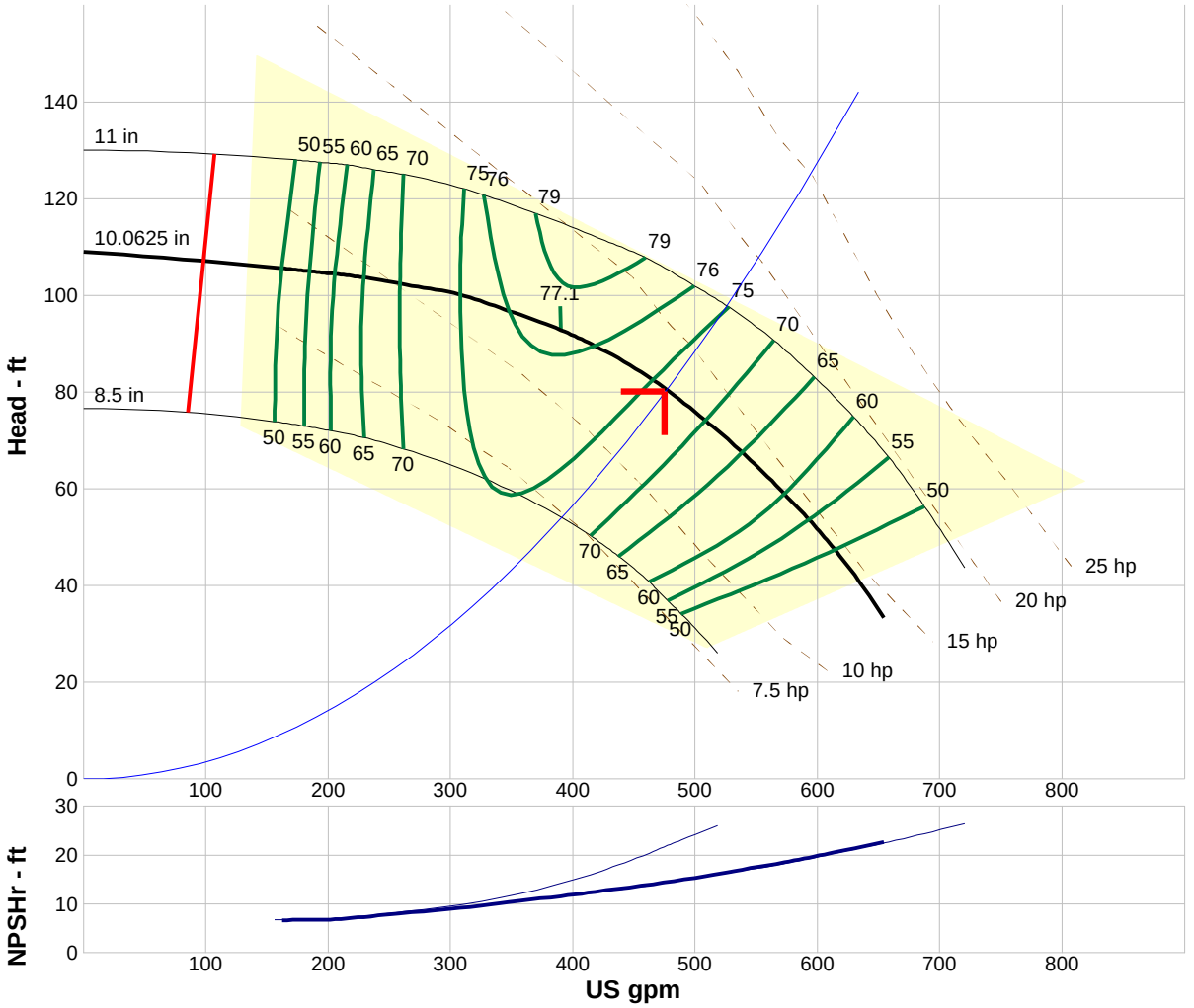
---- Design Curve ----

Shutoff head:	109 ft
Shutoff dP:	47.1 psi
Min flow:	97.5 US gpm
BEP:	77.1% @ 390 US gpm

NOL power:
14.7 hp @ 614 US gpm

-- Max Curve --

Max power:
20.1 hp @ 658 US gpm



Refer to Working Pressure vs. Temperature chart for maximum rated working pressure. All data are subject to change. Contact factory for certified data.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
570	1770	59.6	60.4	14.2	18.4
475	1770	80.6	73.8	13.1	14.4
380	1770	93.8	76.8	11.7	11.3
285	1770	101	72.7	9.99	8.69
190	1770	105	56.4	8.92	6.8

Selected from catalog: Patterson HVAC.60 Vers: 1.2

SECTION 01640

TRAINING REQUIREMENTS

PART I - GENERAL

1.01 SECTION INCLUDES

A. Training of the Owner's operations personnel on the proper care, maintenance and operation of the equipment. Also included are the preparation of lesson plans and training aids and the required qualifications for instructors.

1.02 THE REQUIREMENTS

A. Provide the services of qualified factory trained representatives of the equipment manufacturers for all equipment furnished under this Contract, who shall provide operations and maintenance training.

B. Training shall be completed before Reliability/Demonstration Testing and after field testing & start-up. Training shall not be conducted earlier than sixty (60) days prior to Substantial Completion. Training shall not be conducted on the same day as field testing and start-up services as specified in Field Testing and Startup.

C. Operation and Maintenance Manuals are required to be approved prior to beginning training.

1.03 SUBMITTALS

A. The Contractor shall submit the following items as and when specified in this Section:

1. Lesson Plans
2. Instructor Qualifications
3. Training Aids

1.04 TRAINING

A. The training shall consist of both field instruction and classroom instruction.

1. Field instruction is the Owner's preference and is to be "hands on type training" conducted at the equipment installations. Field training shall identify the location and proper use and function of any valves, pushbuttons, control panels, switches, and other similar equipment required for operation. Field training shall also identify the location and proper use and function of any maintenance equipment such as grease fittings, oilers, isolation valves, safety lockout switches, and other similar equipment.
2. Classroom instruction shall consist of equipment component theory of operation, start-up and shutdown, safety, troubleshooting and routine maintenance training best presented in a classroom environment and as approved by the Owner.

B. All field training shall take place at the project site or at an alternate location approved by the Owner. All classroom training shall take place at the Owner's Operation and Maintenance Facility located in Ashburn, Virginia.

C. Training sessions shall be conducted between the hours of 8:00 a.m. and 4:00 p.m.

D. For each piece of equipment, up to three (3) training sessions shall be conducted for up to 10 people per session for a time period as specified and as appropriate for each equipment/system.

E. Schedule training sessions with the Owner and the Engineer, providing a minimum of fourteen (14) days prior notice of training, subject to the approval of the Engineer and the Owner.

F. Videotaping

1. The Owner reserves the right to videotape all manufacturers' training.

2. The manufacturer may offer prerecorded videotape(s) covering the equipment supplied. If prerecorded videotape(s) are provided, the Owner shall have the right to permanent ownership and use of at least two complete copies.

G. Lesson Plans: Submit lesson plans that include specific information about each item of equipment or equipment system, including controls.

1. Submit lesson plans for approval by the Engineer no less than sixty (60) days prior to the date of the proposed training.

2. The lesson plans shall indicate when training aids are used or referred to during the course of instruction.

3. Outline of lesson plan

a. Equipment Description

(1) Purpose and function of equipment and auxiliary equipment and systems.

(2) Physical arrangement of equipment components and electrical supply.

(3) General function of controls, including automatic and manual operation, interlocks, and shutdowns.

b. Equipment Operation

(1) Operating requirement for equipment to perform satisfactorily.

(2) Typical operating characteristics.

(3) Start-up and shutdown procedures.

(4) Use of controls.

c. Equipment Monitoring

(1) Recommended routine instrument readings and operational checking.

(2) Early warning signs of developing operational or equipment problems.

(3) Description of the facilities Supervisory Control and Data Acquisition (SCADA) System

d. Equipment operational troubleshooting procedures.

e. Safety and Housekeeping

(1) Safety features of the equipment.

(2) Safe work practices.

(3) Housekeeping practices.

f. Description of the use of the equipment manufacturer's Operations and Maintenance Manual (O&M Manual) in regards to operation.

g. Preventive Maintenance Requirements

(1) Maintenance needs for equipment.

(2) Identification of procedure to satisfy maintenance need (relate to equipment manufacturer's O&M Manual, which should have detailed descriptions of maintenance procedures).

(3) Outline or summarize procedures.

(4) Recommended schedule for performing preventive maintenance.

(5) Provide preventive maintenance record forms (if available).

h. Maintenance Inspection Program

(1) Parts, components, and areas of equipment to inspect for routine preventive maintenance.

(2) Recommended frequency of inspection.

(3) Inspection procedures.

(4) Problem identification.

i. Maintenance Troubleshooting

(1) Sections in O&M Manual detailing troubleshooting procedures.

(2) Summarize troubleshooting procedures.

(3) Testing equipment used in troubleshooting.

(a) Demonstration use of specialized testing equipment if supplied with equipment.

(b) Other testing equipment.

(4) Tests used to verify troubleshootings findings.

j. Disassembly and Assembly

(1) Summarize disassembly and assembly procedures.

(2) O&M Manual coverage of subject.

(3) Testing to verify success of corrective maintenance.

k. Equipment Calibration

(1) Calibration needs and tolerances.

(2) Calibration equipment.

(3) O&M Manual listing of calibration ranges, tolerances and settings.

H. Training Aids: Training aids shall be provided by the Contractor as required as an integral part of the training program.

1. Training aids shall include text and/or pictorial handouts specific to the equipment supplied.

a. Submit a copy of the training aids (text and/or pictorial handouts) for approval by the Engineer no less than sixty (60) days prior to the date of the proposed training.

b. Handouts shall be legible and printed on good quality stock.

c. Final handouts shall be provided with lesson plans to each trainee at the time of training.

d. Sufficient quantity of final (accepted) handouts for each attendee (trainee) shall be provided by the Contractor.

2. Additional training aids specific to the facility/system shall be used for maximum training effectiveness and shall include the following as appropriate:

a. Audio visual aids, for example: films, videotapes, slides, overhead transparencies, posters, blueprints, diagrams, and catalog sheets.

b. Models and samples, for example: cutaways, spare parts, tools, miniature models, equipment assemblies, and damaged parts.

c. Training equipment (laptops, projectors, screens, etc.) shall be provided by the Contractor.

3. The use of additional training aids shall be identified in the lesson plan, and a description of the additional final (accepted) training aids shall be provided by the Contractor.

I. Qualifications

1. Submit documentation showing the qualifications of the proposed training specialists (instructor) for approval by the Engineer no less than sixty (60) days prior to the date of the proposed training. Refer to Attachment A for an example of Statement of Instructor Qualifications form. The documentation shall include the following:

a. Experience of the training specialists in operation and maintenance of the equipment;

b. A Statement of Instructor Qualifications;

c. References for previous training on the equipment, including project names, contact names, and phone numbers.

2. The training specialist must be knowledgeable of the equipment's application specific to this project.

3. Only those training specialists whose qualifications have been approved by the Owner shall conduct training.

J. Coordinate training services with the Owner, the Engineer, and Manufacturer.

K. Deliver all training materials to the Owner at least fourteen (14) days prior to scheduled training.

L. The Contractor shall coordinate and verify to ensure prior to the scheduled training times:

1. That all associated construction required to operate the equipment in all normal and anticipated operating modes is complete and that the equipment is ready to be used for training purposes.

2. That the equipment area is well lit and unobstructed so that all training class attendees may access, view and hear the training.

3. That the equipment area is free of construction activities that could present a hazard to training class participants.

M. During the training, as provided in the "Training Schedule" below, the Owner reserves the right to cancel unsatisfactory training at any time. Contractor will be required to reschedule make-up training (at no additional cost to the Owner), at a schedule approved by the Owner.

TRAINING SCHEDULE

SPECIAL SECTION	EQUIPMENT	NO. OF SESSIONS	HOURS/ SESSION
	Vertical Close Coupled Pumps	3	2
	Control & Information Systems		
	Operator Training (Para 1.05)	2	4
	Maintenance Training (Para 1.06)	2	4
	Instrument Training (Para 1.07)	1	2
	General Refresher (Para 1.08)	1	8

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

- END OF SECTION -

Attachment A

STATEMENT OF INSTRUCTOR QUALIFICATIONS

TRAINING INSTRUCTOR NAME:		
Vendor Package:	Staged Demonstration Included (Y/N)	
Technical Specification Name and Number:	Equipment	
Trainees:	# of Groups	# of Sessions
Factory and/or Equipment Training: Type of Training and Dates Attended:		
Type of Training	Training Provider	Dates Attended
Record of Work Experience Related to Equipment		
Employer Name/Address	Job Title and Duties	Dates Employed
Record of Training and Instructional Experience		
Employer Name/Address	Job Title/Duties/Type of Training Provided/Audience	Dates Employed
Project Training References	Project 1	Project 2
Project Name:		
Location:		
Contact Person Name:		
Contact Telephone:		
Contact Person's Role During Project:		
Dates of Training:		
Duties/Type of Training Provided:		

SECTION 01650

FIELD TESTING AND STARTUP REQUIREMENTS

PART 1 -- GENERAL

1.01 SECTION INCLUDES

A. Field Testing and Startup activities shall comprise a phased approach for accomplishing equipment and systems checkout, verification of operation and reliability/demonstration testing as described herein.

1.02 THE REQUIREMENTS

A. Provide the services of qualified factory trained representatives of the equipment manufacturers for all equipment furnished under this Contract, who shall provide the following services:

1. Supervise and assist in the installation of the equipment to ensure proper installation
2. Check the installation of the equipment and make all necessary adjustments prior to testing.
3. Supervise the equipment and system field tests and startup as described herein.
4. Provide additional manufacturer services as specified in each relevant equipment and system specification section in addition to the services specified herein.

B. Provide Field Testing and Startup in compliance with the specified requirements. Approval of the field test results is a prerequisite for obtaining full payment for the equipment furnished.

C. Field testing, startup and Reliability/Demonstration Testing are prerequisites to Substantial Completion and, therefore, shall be completed within the time specified for Substantial Completion.

D. Training as specified in the Training document, shall be completed prior to commencement of the Reliability/Demonstration Test.

E. Field Testing and Startup services shall not be conducted on the same day as training.

F. The Contractor shall include sufficient time in the Construction Schedule to complete all equipment and system testing, troubleshooting, corrections, startup activities and Reliability/Demonstration Testing as specified. The Owner's personnel will witness all Field Testing and Startup activities.

1.03 SUBMITTALS

A. Equipment Checkout Report

B. Test Schedule

C. Test Plans

D. Test Reports

1.04 STARTUP SERVICES

A. Beginning of Startup: Equipment startup and initial operating period shall begin after satisfactory completion and acceptance of the Preliminary and Final Equipment and Preliminary System Field Tests.

B. Completion of Startup: Equipment startup and initial operating period shall be complete when the manufacturer and Engineer have mutually agreed that the equipment is in suitable condition for continuous operation.

1.05 PRELIMINARY CHECKS

A. The following operations shall be conducted in the presence of the field inspectors, as a prerequisite for the Field Tests:

1. Set, align and assemble all equipment and systems in conformance with the manufacturer's drawings and instructions.

2. Check direct coupled shafts with flexible or rigid couplings for parallel and angular misalignment.

3. Check equipment for proper rotation.

4. Check motors for no-load current draw.

5. Run the equipment dry if applicable and check equipment for excessive vibration and noise.

B. Equipment Checkout Report (refer to Attachment to this Section)

1. When the checkout operations have been completed, submit a signed Equipment Checkout Report with all pertinent data from the preliminary checks.

2. An Equipment Checkout Report shall not be valid if not initialed by the Owner or Owner's representative.

3. Field Tests shall not be initiated if valid Equipment Checkout Report have not been provided for the equipment to be tested.

1.06 FIELD TESTS OF EQUIPMENT AND SYSTEMS

A. Provide the services of an experienced and authorized representative of the manufacturer of each item of equipment (excluding minor items of equipment specifically exempted by the Engineer in writing), who shall visit the site and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall revisit the job site as often as necessary until the equipment installation and operation are as specified in the Contract Documents and are satisfactory to the Owner.

B. Each representative shall conduct tests as required on the equipment and furnish to the Owner a written report, certifying that the equipment has been properly installed, lubricated, is in accurate alignment and has been tested, operated satisfactorily under full-load conditions and is ready for operation.

C. Scope of System Testing: System testing shall be required to demonstrate that an equipment item along with interconnections and accessories performs as specified. In addition to specific requirements called for in the specific Sections of the Contract Specifications, the following shall be considered a part of preliminary, final and intersystem test procedures:

1. Variable capacity equipment shall be operated over the full capacity range and at a minimum of three (3) intermediate points for at least thirty (30) minutes at each point.

2. Multiple equipment groupings shall be operated both singly and together up to the design capacity of the system.

3. Manifold and cross-connected groups of units shall be operated using all connecting combinations.

4. All equipment items, including standby units shall be tested. It may be necessary to repeat system tests at the design conditions to ensure that standby units are included in system tests.

5. Each operating unit shall be run for at least one (1) hour alone (equipment field test) and for four (4) hours as a system at design capacity after reaching stable operating conditions.

6. All equipment, interconnections, and accessories shall be checked to verify condition and specified performance capability. Instrumentation and controls shall be tested as part of the equipment to which they are connected.

D. Field Tests

1. Preliminary Field Tests: These tests shall be made with clean water, where practical, and air in lieu of the medium (wastewater, chemicals, etc) for which the equipment and systems are designed.

   a. Preliminary Field Tests of Equipment shall prove that equipment and appurtenances meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration.

2. Final Field Tests: These tests shall utilize the medium (wastewater, chemicals, gas, etc.) for which the equipment and systems are designed.

   a. Final Field Tests of Equipment shall prove that equipment and appurtenances meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration.

E. Successful Tests: For successful test of an equipment component or system, the equipment component or system shall operate trouble free for a continuous period of time as specified. If there are any interruptions in operation during the test, the test shall be repeated until the equipment or system operates trouble free for the specified time period.

F. Test Failure

1. Correction of Defects and Repetition of the Tests: Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor. The test shall be repeated as directed at no additional cost to the Owner.

2. Rejection of Equipment: If the Contractor fails to make the required corrections, or if the corrected equipment fails again to meet the guarantees or specified

requirements, the Owner, notwithstanding having made partial payment for Work and materials of the equipment, may reject the equipment and the Contractor shall remove it from the premises at the Contractor's expense.

G. Contractor's and Equipment Representative's Responsibilities

1. Contractor:

a. Prepare submittals as specified.

b. Coordinate, and schedule with manufacturers to ensure presence of a qualified equipment representative during testing.

c. Assist in startup and testing activities as necessary.

d. Provide power, water, fuel, personnel, chemicals, lubricants, and other process materials and equipment required for specified testing.

e. Coordinate and schedule testing with the Owner. Site visits shall be coordinated with the Owner to allow the Owner's personnel to accompany the representatives during the site visits.

2. Equipment Manufacturer's Representative:

a. Supervise field tests of equipment components and systems under provision of the individual specification section.

b. Inspect equipment onsite and complete and submit an Equipment Checkout Record for each type/style or differing model of equipment provided for the project.

H. Contractor's Liabilities: Contractor shall be liable for, and shall neither have nor make any claim for:

1. Accidents occurring to Owners, Engineers and manufacturer's personnel during the field tests.

2. Improper operation of equipment during tests and instruction periods.

3. Any damage which may occur to equipment prior to the time when the Owner takes over the operation.

I. Test Schedule

1. Perform all testing within the time periods designated in Section 01310, Construction Schedule, during regular weekday (daytime) Working hours (Monday through Friday, between the hours of 7:00 am and 7:00 pm).

2. Submit a Test Schedule within 60 days after the Notice to Proceed.

3. Update the Test Schedule as necessary, until completion of the required field testing.

4. Submit two (2) copies of the updated Test Schedule no later than thirty (30) days before the commencement of the first tests.

5. Content of Test Schedule

a. Proposed test dates,

b. Preliminary or final field test, equipment or system being tested, reliability demonstration test

c. Specification references,

d. Equipment identification numbers

J. Test Plans

1. An approved Test Plan for each equipment item or system is a prerequisite for the Field Tests.

2. A test plan is required for the facility as a whole (Intersystem Test).

3. Include with each Test Plan a manpower schedule indicating the number and qualifications of people to be present for the manufacturer(s) and for the Contractor.

K. Field Test Reports: Test Report Forms will be prepared by the Engineer for the Preliminary and Final field tests. These forms shall be used by the Contractor for data recording and notes during the tests. When the tests have been completed and accepted by the Engineer, the Contractor shall sign the Test Report; the witnessing Engineer will initial the report and take it with him/her for an analysis of the test data.

L. Costs

1. The Contractor shall be responsible for all costs in connection with field testing of equipment and systems, such as electrical power, water, lubricants, instruments, chemicals, labor, equipment, disposal of fluids and waste, etc.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION AND VERIFICATION OF CONDITION

A. The Contractor shall inspect systems and equipment for readiness prior to testing and startup. Hazardous conditions shall be corrected by the Contractor prior to proceeding.

1. Testing and startup shall not proceed using temporary power or temporary instrumentation and control wiring.

2. All electrical and control connections shall be permanent and complete, and all such electrical components and equipment fully functional.

3. Clearly identify all electrical equipment which is energized during testing.

3.02 PREPARATION

A. Prior to testing of equipment or systems verify that all necessary test equipment is in place and operable.

B. The Contractor shall notify the Owner of any startup activities a minimum of 72 hours before the scheduled startup. Notification shall be made during normal working hours.

C. Contractor shall not proceed with any testing until the Test Plan has been approved as specified.

3.03 CONDUCT

A. All tests and startup shall be performed in the presence of a manufacturer's representative, who shall ensure their presence for the entire duration of the test.

B. The Contractor is responsible for the performance and operation of the equipment and systems during testing and startup.

C. Any failures of equipment or systems operated under the direction of the Contractor shall be considered deficiencies and shall be corrected.

D. The Contractor shall repair, replace or modify any equipment or system which fails to perform as specified.

E. The Contractor shall make all adjustments and corrections necessary to achieve normal, stable operation of the systems.

F. Any failure of a system or equipment previously started prior to the date of Final Completion shall require additional testing and startup service to be performed, under the direction of the equipment manufacturer's representative.

3.04 PRELIMINARY FIELD TESTS:

A. Preliminary Field Tests of Equipment: A successful test shall consist of at least one (1) continuous hour of trouble free operation, or longer as specified in individual applicable specification sections. Final Field Tests shall not commence until the completion of successful Preliminary Filed Tests.

B. Preliminary Field Tests of Systems

1. Test all systems by operating the system equipment together as a unit with all related piping, valves, electrical controls and mechanical operations.

2. For a successful test, run each system trouble free for four (4) continuous hours or as specified in individual applicable specification sections.

3.05 FINAL FIELD TESTS

A. Final Field Tests of Equipment: A successful test shall consist of at least one (1) continuous hour of trouble free operation, or longer as specified in individual applicable specification sections.

B. Final Field Tests of Systems:

1. Final field tests shall not commence until completion of successful Preliminary Field Tests.

2. Test all systems by operating the equipment as a unit with all related piping, valves, electrical controls, instrumentation and mechanical operation.

3. For a successful test, run each system trouble free for four (4) continuous hours or as specified in individual applicable specification sections.

3.06 INTERSYSTEM TEST

A. Intersystem Test

1. The Intersystem Test shall not commence until completion of successful Final Field Tests.
2. Test the complete system by operating all of the equipment and systems as a unit with all related piping, valves, ducting, electrical controls, instrumentation, SCADA and mechanical operation. The tests shall prove the systems, equipment and appurtenances are properly installed, free from defects, meet their operating cycles and characteristics as specified.
3. For a successful test, run the complete system trouble free for eight (8) continuous hours.

3.07 RELIABILITY/DEMONSTRATION TEST

A. Following completion of a successful Intersystem Test, the Contractor shall conduct a Reliability/Demonstration Test for the facility.

B. The five-day reliability test shall not be scheduled to take place during any of the manufacturers representatives training efforts.

C. The Owner operated wastewater pump-and-haul operation shall remain in operation for the duration of the five-day reliability test.

D. The test shall be conducted as specified to run the facility in a continuous operational mode for 24 hours per day. The test shall be performed to verify that all pieces of equipment, electrical and control systems, the SCADA system, and other components are operating as specified at normal operating conditions. Major pieces of equipment shall include: pumps, Manual Transfer Switch, control system, SCADA system.

E. The Contractor shall continuously operate the facility as designed for a period of seven (7) calendar days, without shutdowns, delays nor work-arounds in place, in order to demonstrate satisfactory operation of the facility as a whole to the Owner.

F. The Contractor shall provide personnel to operate the facility for the entire duration of the Reliability/Demonstration Test and any required re-tests. The Contractor shall be responsible for responding to any alarm conditions that may occur during the normal business and non-business hours (24 hours per day). Minor adjustments of control settings within the normal operating parameters are allowed as long as the pumping station remains operational and no un-planned alarm signals are generated.

G. The Contractor shall replace any equipment, parts, fuel, or materials that are damaged or consumed during the testing.

H. A successful Reliability/Demonstration Test is a prerequisite of Substantial Completion.

I. The following test procedure is general, and not all-inclusive. It is intended to convey the overall requirements and procedures. The Contractor shall evaluate the proposed procedure and utilize it as a basis for developing the detailed Reliability/Demonstration Test plan:

1. General Requirements – Provide the following:

    a. Piping, as required, for the water in 510 pressure zone to flow through the water booster pumping station suction piping. Include sufficient valves to allow varying the rate of flow. The Contractor shall be responsible for piping and valves necessary to regulate the flow, as required, to perform the required tests.

2. General Procedure:

    a. As water enters the suction piping, the water booster pumping station's control systems shall activate the pumps at their respective control settings.

    b. After the basic operating functions of the water booster pumping station have been demonstrated, the Contractor shall manually activate the station's alarm conditions with the water booster pumping stations control system. The planned alarm conditions shall include, but not be limited to:

        1. One pump failure
        2. Two pumps failure

    e. The Contractor shall respond to all alarms.

    f. The Owner or Engineer will not be required to respond to any alarms.

    g. The Owner or Engineer will be notified of all alarms via the SCADA system.

    h. The water booster pumping station's normal control system shall be in continuous operation for the duration of the five-day reliability test and any required re-tests.

    i. The Reliability/Demonstration Test shall be monitored by the Loudoun Water SCADA system for the entire duration of the test and any required retests.

3. Disposal:
    1. All test equipment including storage tanks, water, valves, piping, etc. shall remain the property of the Contractor and shall be properly disposed of after the Reliability/Demonstration Test.

J. Test Failure

1. The following (at a minimum) shall be considered conditions for a failed test:

    a. Failure of any major piece of equipment or system.

    b. Leaks of any kind including leaks from any pipes, equipment, or structures.

    c. Failure of any equipment or system including controls and SCADA such that the facility cannot continue to operate safely and perform as intended within the design requirements.

K. Re-Test

1. If the Reliability/Demonstration Test fails for any reason, the Contractor shall conduct a re-test.
2. Prior to scheduling a re-test the Contractor shall provide a written description of the failed test including:
    a. A description of the cause or causes of the failed test.
    b. A description of any damage caused by the failure of the test.
    c. Any repairs to the facility that are required because of the failed test.
    d. Any changes to the facility that are required in order to obtain a successful test.
3. Upon approval by the Owner, the Contractor shall make all required repairs or changes to the facility prior to the re-test.

- END OF SECTION -

Attachment

EQUIPMENT CHECKOUT REPORT

PROJECT NAME:	
PROJECT NUMBER:	
CONTRACT NUMBER:	
PROJECT DESCRIPTION:	
CONTRACTOR'S NAME:	

I am an experienced and authorized representative of the manufacturer of the following equipment:

Specification Section	Equipment Description

Initial each line as applicable:

_____ I am aware of the site storage conditions of the equipment and my field check indicates the method of storage has not adversely affected the equipment. (If not initialed, indicate reasons under Comments.)

_____ I have inspected, checked, and adjusted the equipment items named above. In my opinion, the equipment has been properly installed and lubricated, is in accurate alignment, and is free from any under stress imposed by connecting piping or anchor bolts.

_____ I have observed the operation of each item of equipment under full load conditions and, in my opinion, the equipment operated satisfactorily. (If not initialed, indicate reasons under Comments.)

_____ Initial operation was not observed (Initial the following statement which applies.)

_____ I want to be notified so that I may be present during initial operation of the equipment.

_____ It is not necessary that I be present for the initial operation of the equipment. My absence will not affect the manufacturer's warranty

_____ Equipment installation is not complete at this time. (Indicate under Comments all items of work that must be completed before initial operation.)

Comments:

_____

_____

_____

_____

Distribution: ❑ Owner (original) ❑ Resident Project Representative ❑ Contractor ❑ Originator	Equipment Manufacturer's Name:	
	Signature of Authorized Representative:	
	Date:	
	Printed Name:	
	Employer:	
	Address:	
	Telephone:	

SECTION 16495

VARIABLE FREQUENCY DRIVE SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test and place in satisfactory operating condition all variable frequency drives (VFD's) as specified herein and indicated on the Drawings.

1.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Certified Shop Tests

a. The VFD's specified in this Section shall be witness shop tested and inspected in accordance with the equipment manufacturer's standard procedures. The testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified.

b. Factory test the complete variable frequency drive system in accordance with IEEE and NEMA standards with these Specifications. In addition, the variable frequency drive system shall be tested for efficiency as defined in this Specification and for operational integrity during output short circuit conditions. Short circuit test shall demonstrate that the equipment will successfully protect against and survive a minimum of three (3) successfully repeated phase-to-phase short circuits at the drive output terminals.

c. Variable frequency drive system components, including power transistors, GTOs, SCRs, IGBT's, diodes shall be 100 percent inspected and tested, including temperature cycling and inspected and tested including temperature cycling and ambient high temperature of 65 degrees Celsius load testing. All integrated circuits shall be inspected, pass/fail tested, temperature cycled and ambient high temperature tested. Small components, including small signal semiconductors, resistors, capacitors, diodes, etc. shall be lot sampled and tested for functionality. Test printed circuit boards under a temperature cycled 20 hour load test and functionally bench test prior to unit installation. Inspect all final assemblies and test at full load with application of line-to-line and line-to-ground bolted faults. The variable frequency drive system shall electrically trip off line under these conditions without device failure.

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2. Certified Shop Tests and Reports

   a. Submit description of proposed testing methods, procedures, and apparatus.

   b. Submit notarized and certified copies of all test reports.

   c. Submit factory bench-test data to indicate that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.

3. Field Tests

   a. Field tests shall be performed in accordance with requirements specified in the Field Testing and Startup Requirements.

C. Shop test does not relieve Contractor from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the Contractor of responsibilities.

D. The Contractor shall successfully complete acceptance test procedures on the assembled drive system that demonstrate compliance with the requirements of this Specification. The test plan shall be submitted for acceptance at least 10 days prior to the planned test date.

E. Submit signed and dated certification that all of the factory inspection and testing procedures described herein have been successfully performed by the Contractor prior to shipment.

1.03 SUBMITTALS

A. , The Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Harmonic Study Report

3. Programming Guides/Manuals

4. Operation and Maintenance Manuals

5. Spare Parts List

6. Special Tools List

7. Shop Test Plan

8. Reports of Certified Shop and Field Tests

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Drawings submitted by the manufacturer shall be complete and documented to provide the Owner with operations and maintenance capabilities.

D. Shop drawings for each VFD shall include but not be limited to:

1. Layout drawings of the variable frequency drive system that includes all cabinet or enclosure dimensions, access details, and weights.

2. Layout drawings of panels or enclosures showing size, arrangement, color, and nameplates. Drawings shall include the physical arrangement of door mounted devices located on the variable frequency drive enclosure. Sufficient detail shall be provided for locating conduit stub-ups. General "catalog data sheet" layout drawings which are not specific to the systems specified herein are not acceptable.

3. Custom schematic and interconnection wiring diagrams of all electrical work, including terminal blocks and identification numbers, wire numbers and wire colors. Standard schematics and wiring diagrams that are not custom created by the manufacturer for the variable frequency drives for this project are not acceptable. These drawings shall be circuit specific for each motor-load combination (e.g. influent pumps, RAS pumps, effluent pumps, raw water pumps, etc.). Indicate all devices, regardless of their physical location, on these diagrams. Specific equipment names consistent with the Drawings shall appear on each respective diagram.

4. Complete single line diagrams indicating all devices comprising the variable frequency drive system including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system. Electrical ratings of all equipment and devices shall be clearly indicated on these single line diagrams.

5. Complete Bills of Material and catalog data sheets for all equipment and devices comprising the variable frequency drive system.

6. A complete list of recommended spare parts, including item descriptions, recommended quantities, and unit costs. The recommended list should be based on a maintenance plan where the Owner will remove and replace failed items to the lowest replaceable module/component level.

E. The shop drawing information shall be completed and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "Soft Cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

F. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each VFD and bypass starter. These final drawings shall be plastic laminated and securely placed inside each VFD and starter door and included in the O&M manuals.

G. Product Data shall include, but not be limited to:

1. Functional diagrams that identify major system functional blocks and interfaces.

2. Special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.

H. Harmonic Study and Data shall include but not be limited to:

1. Report of Harmonic Study to determine the harmonic distortion present in the voltage and current waveforms on motor terminals and in the electrical distribution system(s) caused by the variable frequency drive system as specified herein.

2. Voltage and current waveforms supplied by variable frequency drive at the motor leads.

3. Necessary descriptions regarding calculation method, assumptions, values and notations, basis for input information, manufacturer's harmonic content data, and calculation results interpretation.

I. Programming Guides and Manuals shall be submitted. If the variable frequency drive systems require computer software or configuration, provide copies of all programming guides/manuals. Provide a minimum of one (1) copy of drive configuration software. Flow charts and listings of software developed shall be submitted to the Engineer. Submit final flow charts and program listings no later than 4 weeks prior to factory testing of the system.

1.05 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals to be reviewed and accepted by the Owner..

B. Operation and Maintenance Manuals shall also be provided in electronic format on CDROM.

1.06 TOOLS, SUPPLIES, AND SPARE PARTS

A. The VFD's and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished by the Contractor to the Owner.

B. The Contractor shall furnish the following spare parts for each VFD:

1. One set of all power and control fuses for each variable frequency drive.

2. One fully functional main control circuit board for each variable frequency drive.

3. One of each inverter power semiconductor for each rating supplied for each variable frequency drive.

4. Spare auxiliary equipment as specified in Article 2.09.

C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.

E. Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

F. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the

Owner's operating personnel in its maintenance and operation as outlined in the General Conditions, Division 1, and Section 11000, Equipment - General Provisions. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of one (1) working day during installation and start-up/configuration of the equipment.

2. One trip of one (1) working day after acceptance of the equipment.

3. One trip of one (1) working day during the warranty period.

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Resident representative on each day he is at the project.

1.08 IDENTIFICATION

A. Each VFD shall be identified by the circuit number and equipment name as indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each VFD.

1.09 TRAINING

A. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section.

B. Provide the services of an experienced, factory trained technician or service engineer of the variable frequency drive manufacturer at the jobsite for minimum of 3 days for training of Owner personnel, beginning at a date mutually agreeable to the Contractor and the Owner. The technician shall be on duty at the site for at least 8 hours per day and shall be available 24 hours per day when required to advise concerning special problems with equipment and systems.

C. Include in the bid the training of personnel in the operation and maintenance of each furnished variable frequency drive pump control system. For the purpose of this training section of the Specifications, a system is by definition a group of pumps or equipment which serve a common function (e.g. VTSH pumps, etc.). Training shall include at least one session for 2 designated employees for each system.

1.10 WARRANTY

A. Contractor shall warrant that the material and workmanship of all components and the operation of the variable frequency drive system and auxiliary equipment is in accordance with the latest design practices and meets the requirements of this Specification.

B. Warranty work shall include, but not be limited to, the following:

1. Replace components found to be faulty and make changes in equipment arrangement or adjustments necessary to meet the equipment or functional requirements or this Specification.

2. Warranty shall include system rewiring and substitution and rebuilt or additional equipment required during trial operation or subsequent operation of the unit during the period of this warranty.

3. Warranty shall be in effect for a period of 24 months following final acceptance of the system.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall obtain the VFDs from one manufacturer who shall also manufacture the enclosure and major equipment components. The manufacturer shall have a minimum of five years experience in the production of similar units and shall have a general distribution to the electrical trade. Subcontracting of wiring will not be acceptable.

The VFDs shall be PowerFlex 700 as manufactured by Allen Bradley.

C. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings. Where not indicated, the control circuits shall be standard three-wire "start-stop" and the Contractor shall furnish wiring accordingly.

D. Variable frequency drive manufacturer shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all load, torque, speed and performance requirements from the respective sources and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.

E. The Contractor and variable frequency drive system manufacturer are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are circuit breakers, motor circuit protectors, magnetic starters, relays, timers, control and instrumentation products, pilot devices including pushbuttons, selector switches and pilot lights, enclosures, conduit, disconnect switches, terminal boxes, and other equipment.

2.02 PRODUCT REQUIREMENTS

A. Variable speed drives shall be adjustable frequency, adjustable voltage, pulse width modulated (PWM) design. The units shall be microprocessor controlled, fully digitally programmable, and capable of precise and repeatable speed regulation of three phase 480 volt AC NEMA Design B induction motors. Variable frequency drives for other than NEMA Design B induction motors (e.g. NEMA Design C) shall be coordinated with the requirements of that respective load.

Drive units shall perform continuous self diagnostics as well as load and drive self check on startup.

B. All drives shall have permanently mounted programming and display modules. These modules shall provide programming access to all drive parameters, display all fault codes to assist with diagnostics and provide a display of output speed in percent or load.

C. This specification describes variable speed motor control which includes the design, fabrication, testing, installation and support requirements for variable frequency drive systems for 3-phase, squirrel cage rotor, induction motors driving pumps or other equipment. In addition to the variable frequency drive system, provide a reduced voltage solid state starter for bypass starting during variable frequency drive downtime, where specified herein and indicated on the Drawings.

D. Each variable frequency drive to be a complete alternating current electric drive system including hardware, software, technical data, and spare parts necessary to accomplish variable speed operation of an induction motor and load combination in accordance with the requirements as indicated on the Drawings and as described in these Specifications. Contractor shall refer to Section 17900 of the Specifications for a functional control description of each variable frequency drive system.

E. Variable frequency drive system manufacturer shall be responsible for the design and performance of the entire drive system and shall either manufacture all items of equipment or supply them using coordinated specifications furnished to the original equipment manufacturers to insure compatibility and performance in accordance with this Specification. Variable frequency drive manufacturer shall coordinate with suppliers of the drive motors and driven equipment. Motors shall be as specified in Section 15170 and other specific equipment Sections of the Specifications.

F. Variable frequency drive system shall be suitable for operation as part of a 480 VAC, 3-phase, 60 Hertz power distribution system. The complete variable frequency drive system shall withstand the mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage.

G. The variable frequency drive system shall be suitable to operate, at times, on a limited power source engine-generator set. The system shall be provided with equipment and devices to prevent waveform distortion as specified herein.

H. Provide control and sequence logic as specified herein and indicated on the Drawings. Control and sequence logic shall be designed such that the motor-load combination can be operated in the manual mode upon control and sequence logic failure, including all necessary personnel and equipment safety interlocks.

I. Design each variable frequency drive motor drive speed control system so that through simple programming by either factory engineers or Owner's trained operating personnel, specific control and protection functions can be attained.

2.03 DESIGN REQUIREMENTS

A. Each variable frequency drive system shall meet the requirements of this Specification without derating any of the induction motor operating parameters including service factor and nameplate horsepower. The variable frequency drive system manufacturer shall specifically identify special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.

B. The variable frequency drive shall consist of a 6 pulse diode semiconductor rectifier system, direct current link, and pulse width modulated inverter. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the induction motor at the desired speed.

C. Variable frequency drive shall operate from fixed frequency power supply and convert this input power into variable speed induction motor shaft power as required by this Specification. Provide each variable frequency drive with a motor circuit protector as indicated on the Drawings which shall be padlockable. Provide each variable frequency drive with 5% line reactors at the input. Include the necessary drive controllers and output contactors to accomplish the intended control of the variable frequency drive system.

D. The drive shall operate the motor and produce full rated nameplate horsepower at the motor output shaft without exceeding motor nameplate full load current and with the motor not exceeding rated total temperature not including the additional temperature increment that constitutes the motor service factor. Motor shall retain its service factor when operated by the variable frequency drive.

E. The overall drive system efficiency shall be a minimum of 95 percent when operating the specified motor-load combination at rated voltage, frequency, and current.

This efficiency shall be calculated as follows:

$$\text{Efficiency (\%)} = \frac{\text{Power (Load)}}{\text{Power (Supply)}} \times 100$$

F. Power (Load) is the total 3-phase power delivered to the motor, measured at the output terminals of the drive system, including output filters or transformers. Power (Supply) is the total electrical power delivered to the drive system, measured at the input terminals of the variable frequency drive including input filters, line reactors, isolation transformers, or other harmonic distortion suppression equipment. Include power input required for auxiliary equipment (e.g., controls, fans, air conditioning, pumps) for complete system operating in this Power (Supply) total.

G. Variable frequency drive shall provide smooth, stepless changes in motor speed and acceleration over the entire operating speed range from minimum to maximum speed (revolutions per minute). The variable frequency drive shall be provided with maximum and minimum frequency limits.

H. Variable frequency drive system to maintain a desired output frequency (setpoint) with a steady state accuracy of 0.5 percent of rated frequency of 60 Hertz for a 24 hour period.

I. Variable frequency drive to have an automatic current limit feature to control motor currents during startup and provide a "soft start" torque profile for the motor-load combination. The variable frequency drive shall also limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short circuit. The current limit protection setting shall be field adjustable.

   Variable frequency drive shall be furnished with programmable electronic overload and torque limits.

J. Drive system shall achieve a desired output frequency (setpoint) with a repeatability of 0.1 percent of rated frequency of 60 Hertz.

K. Drive system to be capable of operating the specified load continuously at any speed within the operating speed range of 10 percent to 100 percent of rated speed. The minimum and maximum continuous operating speeds shall each be adjustable within this speed range. The variable frequency drive shall provide for field adjustment of these setpoints.

L. Drive system controls to be microprocessor-based and have controlled linear acceleration capability to ramp up the speed, revolutions per minute, of the motor-load combination from the minimum selected operating speed to the maximum selected operating speed in a minimum of 30 seconds. Provide two (2) field-adjustable speed setpoints for the variable frequency drive to skip equipment resonant frequencies. Provide controlled linear deceleration capability. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.

M. Voltage or current unbalance between phases of the variable frequency drive output voltage shall not exceed 3 percent of the instantaneous values. The variable frequency drive system shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 3 percent. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.

N. Variable frequency drive system to operate continuously without interruption of service or damage to equipment during transient input voltage variations of plus or minus 10 percent for a duration of 15 cycles. Unacceptable voltage fluctuations on the supply bus shall cause under or overvoltage protection to trip and remove supply voltage from the drive system. Variable frequency drive output voltage regulation shall be plus or minus 2 percent.

The variable frequency drive system shall be furnished with line surge protection.

O. The Contractor shall size variable frequency drive system and components to provide, indefinitely, motor load current equal to 110 percent of the motor nameplate full load current.

The Contractor is fully responsible for the review of the mechanical specifications to determine specified motor speed, horsepower and full load amperes. This information is available in the applicable mechanical specifications for each pump, drive, conveyor, blower, etc. Reference the Table of Contents.

P. The audible noise (sound pressure) level of a motor when operated from no load to full load with the variable frequency drive described herein shall not increase more than 5 decibels (dbA), at 5 feet in any direction from the motor, above its noise level when operated from a utility power source without the variable frequency drive.

Q. Variable frequency drives shall be provided with output reactors or filters to prevent elevated voltage levels at the motor terminals.

2.04 OPERATING CONDITIONS

A. The following operating conditions are applicable for all equipment of this Specification.

1. Humidity: 0-95 percent.

2. Ambient Temperature: Minus 20 degrees Celsius to plus 40 degrees Celsius.

3. Altitude: up to 3,300 feet

4. Power Supply: 480 volts, 3-phase, 60 Hertz.

5. Available Short Circuit Duty: as specified herein.

2.05 SYSTEM FEATURES AND CHARACTERISTICS

A. Controls and indicators to accomplish operation and maintenance shall be located on the variable frequency drive equipment assembly as specified herein and indicated on the Drawings. As a minimum, each VFD shall provide indication of the following:

1. Digital Speed Indicator: Revolutions per minute (input from tachometer).

2. Variable Frequency Drive Mode Indicator: Red; as required.

3. Bypass Mode Indicator: Red; as required;

4. Input Voltage

5. Output Voltage

6. Output Current

7. Output Frequency

8. Output Speed: 0-100%

9. Drive Ready Indicator: White

10. Run Indicator: Red.

11. Running Time Meter.

12. Enclosure Overtemperature.

13. Alarm Indicator: Amber.

14. Alarm Read-out: Display.

B. Each VFD shall provide the following automatic and manual controls:

1. Hand-Off-Auto Selector Switch (as required).

2. Start and Stop pushbuttons (as required).

3. VFD - Bypass Selector Switch (as required).

4. Local - Remote Speed Control Selector Switch (as required).

5. Local Speed Potentiometer.

6. Alarm Reset Pushbutton.

7. 24 VDC coil pilot relay for remote run command.

8. Alarm auxiliary contacts and other devices as indicated on the Drawings and specified.

9. Provision for a run permissive from other equipment when the drive is in "Auto".

C. Each VFD shall provide "potential-free" output contacts for the following conditions:

1. Drive running.

2. Drive in "Auto" and all trip conditions cleared.

a. Pilot devices shall be as specified in Section 16902, Electrical Controls and Relays.

D. Variable frequency drive system shall provide a 4-20 mADC output signal that is proportional to the drive output frequency for use as speed feedback or control and remote speed indication.

E. Variable frequency drive system shall accept a 4-20 mADC input command signal to control the output frequency in the automatic and/or manual control modes as specified herein or indicated on the Drawings. The system shall accept the input increase/decrease command with a resolution that permits incremental changes in speed, revolutions per minute, equal to or less than 0.1 percent of rated speed.

F. When operating in the automatic mode, the variable frequency drive system shall shut down during a power outage. Upon restoration of normal power and after an adjustable time delay (0-2 minutes; motor has coasted to zero speed and there is no backspin), the variable frequency drive system shall automatically restart and then ramp up to speed as required by the control system. The process operator shall not be required to reset the system manually after a shutdown caused by a power outage.

G. Variable frequency drive shall be furnished with a multiple attempt restart feature.

H. Furnish a door mounted selector switch or other pilot device for those variable frequency drives where an additional speed reference signal (e.g., from a remote potentiometer, an analog output from a setpoint (PID) controller, an analog output from a programmable logic controller, or similar analog signal) is to be supplied to the variable frequency drive in addition to the door mounted manual speed control.

I. Provide a motor circuit protector with shunt trip coil and current-limiting fuses for each variable frequency drive. Provide each variable frequency drive with its respective drive controller and output contactors for each motor.

J. Include in each variable frequency drive system an automatic trip feature which will open the output contactor and remove the drive output from the motor and allow it to decelerate safely. This automatic system shall trip and indicate the fault only upon the following conditions:

1. Output voltage unbalance (trip threshold field set).

2. Open phase.

3. Motor overload.

4. Motor stator winding fault (phase-to-ground, phase-to-phase).

5. Loss of input power to the variable frequency drive or unacceptable voltage variation.

6. High variable frequency drive equipment temperature.

7. Variable frequency drive system failure as determined by the manufacturer.

8. Component failure.

9. Overcurrent.

10. Undercurrent.

K. Provide variable frequency drive system with transmitted and received radio interference protection. In addition, provide protection against starting a rotating motor, both directions (coasting to zero speed and backspin). In the event that a motor automatic restart feature (catch the motor "on-the-fly") is provided in the drive controller as standard, this feature shall be capable of being disabled.

L. Variable frequency drive design shall include on-line diagnostics, with an automatic self-check feature that will detect a variable frequency drive failure which in turn affects motor operation and generates an alarm contact output rated for 125 VDC suitable for interfacing with the control system.

1. Diagnostics shall operate a visual alarm indicator that is visible on the variable frequency drive equipment cabinets without opening the cabinet doors.

2. Diagnostics shall provide an easily readable output that will isolate a failure.

3. Provide an event and diagnostic recorder to printout in narrative English of the specific fault(s) and the sequence in which the faults occurred. An indication of the "First Out" failure is a minimum for fault sequence detection.

4. Provide a normally open dry contact for each alarm function to enable remote indication. An Ethernet network link shall be provided to network the variable frequency drive to the PLC.

2.06 ENCLOSURES

A. Unless otherwise specified or indicated on the Drawings, the variable frequency drive enclosures shall be NEMA 12, force ventilated, dead-front, with front accessibility. VFDs integrated into motor control center structures shall meet the enclosure requirements for MCCs as specified in Section 16482, Motor Control Centers. Design enclosures for both bottom and top entry of cables. Design variable frequency drive system so that rear cabinet access is not required for operations, maintenance, and repair tasks. Other enclosure requirements are:

1. Treat metal surfaces and structural parts by phosphatizing prior to painting.

2. Apply a gun-metal gray undercoat to enclosures which is equal to zinc chromate.

3. Finish exterior of the enclosures in ANSI-61 gray enamel or furnish in a color to match the complete line-up of equipment as indicated on the Drawings and accepted by the Owner.

4. The doors shall have full length piano type hinges.

5. Brace each door to prevent sag when fully open.

The Contractor shall reference the Drawings for maximum dimensions of the VFDs.

B. Furnish each variable frequency drive system with the control switches, alarm lights and indicators as specified herein and as indicated on the Drawings. Furnish main circuit breakers with an external operating handle interlocked with the door so that the door cannot be opened unless the disconnect is in the OFF position. Power supply to the motor from both the variable frequency drive and the bypass starter shall be capable of being positively locked in the OFF position. The disconnect shall be interlocked so that equipment cannot be energized when the door is open.

C. Electrical bus, including ground bus, shall be tin-plated copper. Power and control wiring shall be copper, color coded and identified in accordance with these Specifications.

D. Equipment shall be of modular construction allowing normal maintenance and repair to be done with ordinary hand tools. Design and install power electronic component assemblies so that, where practicable, components can be individually removed and replaced.

2.07 HARMONIC DISTORTION SUPPRESSION

A. All stand alone VFD's shall be provided with harmonic filters. Harmonic filters shall be passive, series connected, low pass consisting of inductors and capacitors plus damping resistors to prevent excitation and resonance. Active harmonic filters based on transistor technology shall not be used.

B. Harmonic filters shall be UL listed per UL-508C. Filters shall be stand alone, NEMA Industrial Type 12 enclosures.

C. Harmonic filters shall reduce the THID to 12% or less from 0%-100% load and shall reduce the THID to 8% at full load.

D. Harmonic filters shall not cause resonance within the power system.

E. Harmonic filters shall be Matrix Filters by MTE Corporation, TCI equivalent, or equal.

F. Harmonic filters shall contain a contactor to disconnect the filter capacitor bank when the drive is not running. This contactor shall be controlled by a dry contact from the VFD run relay. The contactor shall contain 1 normally open and 1 normally closed auxiliary contact wired to a customer terminal block.

2.08 BYPASS STARTERS

A. Variable frequency drive manufacturer shall furnish and the Contractor shall install reduced voltage solid state motor starters for bypass operation and associated accessories as specified herein and as indicated on the Drawings. The bypass starter shall be manufactured by the same manufacturer as the VFD.

B. Provide bypass starters with full capacity rated contactors, each interlocked with the contactors of the variable frequency drive.

C. Where a bypass starter is to be furnished and installed in conjunction with a variable frequency drive as part of a motor control system, the variable frequency drive and the bypass starter equipment shall be designed and manufactured to allow qualified plant personnel to safely test, maintain, and work on the VFD or the bypass starter while the motor is running. That is, plant personnel should be able to safely work on the bypass starter while the load is running via the VFD and safely work on the VFD while the load is running via the bypass starter.

D. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing. The starter shall meet all applicable requirements of this Section and other sections in this Division.

E. The RVSS shall be suitable for continuous operation at 115% of its continuous ampere rating. To ensure that pump/motor load starting torque requirements are met, the Contractor shall furnish the starter of the next higher maximum continuous current rating than otherwise required based on the full load ampere rating of the motor.

F. The RVSS shall be suitable for the following environmental conditions:

1. Operating Temperature: 0-40 degrees C

2. Humidity: 0-95 percent non-condensing.

3. Altitude: up to 3,300 feet.

G. The RVSS shall be suitable for operation on a 480VAC, 3-phase, 60 Hertz system.

H. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV. Units using triacs or SCR/diode combinations are not acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt effects.

I. The paralleling run bypass contactor shall energize when the motor reaches full speed and close/open under one (1) times motor current. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions. The coil shall have a lifetime warranty.

J. The starter shall be provided with electronic overload protection as standard and shall be based on an inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIP switch setting on the device keypad. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter. The starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad. The starter shall be capable of either an electronic or mechanical reset after a fault. Units using bimetal or eutectic alloy overload relays are not acceptable. Overtemperature protection (on heat sink) shall be standard.

K. The starter shall provide protection against improper line-side phase rotation as standard. The starter shall stop the motor load if a line-side phase rotation other than A-B-C exists. This feature may be disabled via a DIP switch on the device keypad.

L. The starter shall provide protection against a phase loss or unbalance condition as standard. The starter shall stop the motor load if a 50% current differential between any two phases is encountered. This feature may be disabled via a DIP switch on the device keypad.

M. The starter shall provide protection against a motor stall condition as standard. This feature may be disabled via a DIP switch on the device keypad.

N. The starter shall provide protection against a motor jam condition as standard. This feature may be disabled via a DIP switch on the device keypad.

O. The starter shall be provided with a form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. The contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate the type of fault (Overtemp, Phase Loss, Jam, Stall, Phase Reversal, and Overload).

P. The starter shall be provided with an unpowered internal “Run” contact rated for 24VDC or 120 VAC operation.

Q. The following control function adjustments on the device keypad shall be provided:

1. Selectable Torque Ramp Start or Current Limit Start

2. Adjustable Kick Start Time, 0-2 seconds

3. Adjustable Kick Start torque, 0-90%

4. Adjustable Ramp Start Time; 0.5-180 seconds

5. Adjustable Initial Starting Ramp Torque; 0-100%

6. Adjustable Smooth Stop Ramp Time; 0-60 seconds.

R. Enclosed units shall include a [motor circuit protector (MCP)] [thermal-magnetic circuit breaker] for short-circuit protection and quick disconnect means. The unit shall include a 24 VDC power supply to be used as the primary control voltage source. An additional 120 VAC control power transformer, fused on both the primary and secondary sides, shall be provided as an additional control power source to power such devices as motor space heaters, solenoid valves, and similar control elements. Input and output isolation contactors shall be furnished as indicated on the Drawings.

S. Unless otherwise specified or indicated on the Drawings, the RVSS enclosure shall be NEMA 12, force ventilated, dead-front, with front accessibility. The enclosure shall be designed for both bottom and top entry. The enclosure shall be designed so rear access is not required for operations, maintenance, and repair tasks. The doors shall have full length piano type hinges and shall be braced to prevent sag when fully open. Other enclosure requirements are:

1. Treat metal surfaces and structural parts by phosphatizing prior to painting.

2. Apply a gun-metal gray undercoat to enclosures which is equal to zinc chromate.

3. Finish exterior of the enclosures in ANSI-61 gray enamel or furnish in a color to match the complete line-up of equipment as indicated on the Drawings and accepted by the Engineer.

T. The complete starter assembly shall be rated per UL 508D for a withstand rating of 65 kAIC rms. Starters enclosed in motor control centers shall be of the same manufacturer.

U. The following accessories and spare parts shall be provided for each starter:

1. Lug kits for both the line and load side of the starter.

2. One (1) user’s manual for each frame size of starter.

3. One (1) spare 24VDC power supply for each size used.

2.09 MISCELLANEOUS

A. Encapsulate critical components in ceramic or metal.

D. Auxiliaries, including fans, that are required for rated load operation at maximum ambient temperature, shall be 100 percent redundant. A new and unused spare replacement fan(s) or air conditioning unit(s), shipped in original carton, may be acceptable.

E. An Allen Bradley 825-P Modular Protection System shall be provided to monitor the motor RTD's and provide additional protective device functions where indicated on the Drawings.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The VFD's shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

B. Install VFD's to allow complete door swing required for component removal. This is specifically required where a VFD is set in the corner of a room.

C. Include in the bid an allowance for factory-trained service personnel, other than sales representatives, to supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested by the Contractor and the results of these tests have been accepted by the Engineer.

3.02 PAINTING

A. All metal surfaces of the motor control equipment shall be thoroughly cleaned and given one prime coat of zinc chromate primer. All interior surfaces shall then be given one shop furnished coat of a lacquer of the nitro-cellulose enamel variety. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be as approved by the Engineer. Color chips shall be forwarded to the Engineer for color selection and approval prior to finish painting. The interior of the VFD enclosure shall be painted white.

B. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

3.03 RUBBER MATS

A. A three foot wide rubber mat shall be furnished and installed on the floor and in front of each VFD assembly. The mat shall be long enough to cover the full length of each VFD system. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting.

- END OF SECTION -